Modern Refrigeration & Air Control

THE UNIVERSITY

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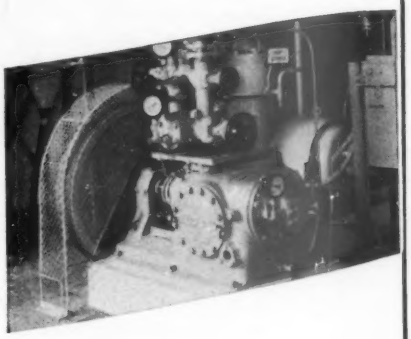
MODERN REFRIGERATION

and Air Control News

Incorporating
COLD STORAGE AND PRODUCE REVIEW
and ICE AND COLD STORAGE

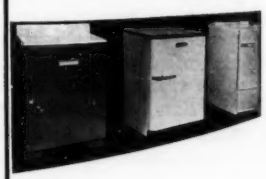
Established 1898

Contents



Editor-in-Chief:
THEODORE A. RAYMOND

Advertisement Manager:
J. A. Hutchinson



Maclaren House,
131 Great Suffolk Street,
London, S.E.1.

Telephone: HOP 5712
Telegrams:
Buns, Souphone, London

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December . 1958

A Happy Christmas and a Prosperous New Year

"MODERN REFRIGERATION" **EXTENDS THE AGE-OLD GREETING TO READERS AND ADVERTISERS, AT HOME AND ABROAD, WITH THE SINCERE HOPE THAT TIME WILL NEVER VITIATE THE WONDER OF THIS SEASON.**

● Having conveyed our good wishes for the coming festive season, it is bound to strike a jarring note if we raise the question of radiation of foodstuffs. But raise it we must, since the top brass in this field has been in conclave at Harwell.

● Never let it be said that this journal has ever stood in the way of progress but the thought of wholesome, nutritious food being subjected to the gamma ray still fills us with horror. It would appear to be one of the curses of this age that as soon as man is within sight of achieving one particular objective (in this case, the perfection of food storage methods along traditional lines) a diversion is caused to weaken his effort. Such is the measure of man's discontent.

● Have the "gamma ray boys" ever produced a sound argument for tampering with God's food in their peculiarly sinister way?; we have yet to hear it. At least we are consoled by the fact that, to quote the Food and Agricultural Organization, "rapid results cannot be expected from research in a field full of economic as well as scientific problems that have never been faced before."

● In this country, complete sterilization of foods is not the aim as it is in the United States. British research workers aim at "radiopasteurisation," which will be largely used in combination with refrigeration, to prolong storage life. One difficulty here is, that in Britain, the number of homes having a refrigerator is comparatively few; and these foods will need to be cold-stored in the home if they are to be safe to handle.

● We feel sure that the many thousands of housewives who are now buying refrigerators at the new heightened tempo have no thought that certain people plan to fill their cabinets with sterilized food in the not-too-distant future.

● At least, we did not hear it voiced last month at the Women's Press Club when leading representatives of the national and technical press attended a party given by the Domestic Refrigeration Development Committee. Refrigerator models from the eight DoRDeC companies were on show and housecraft advisers were present to demonstrate the theme "This is your life—with a refrigerator." Each model was packed with new ideas in menu-planning and recipes, designed to suit the needs of every household. Miss Lorna Moore, chairman of the Women's Press Club, thanked the committee for their valuable work in encouraging the use of refrigeration over the past two years. Mr. T. Whittaker, director of the British Refrigeration Association, spoke of recent progress in the industry, but emphasized a further need to encourage the public in the use of domestic refrigeration.

● Certain criticisms have lately been levelled at British cold stores, particularly in regard to rates. According to the testimony of two industry leaders from north of the border, the efficiency of these establishments compares very favourably with those in the New World.

● During a recent visit to Canada and America, Mr. W. A. P. Milne, of Wm. Milne Ltd., Glasgow, and Mr. James Mackenzie, of the North British Cold Storage & Ice Co. Ltd., Leith, had the opportunity of visiting some cold stores in an endeavour to compare their general efficiency and service to the customer with those of which they

have knowledge within these shores. It was a shade unfortunate that circumstances prevented them from visiting any of the post-war constructions, as these are mostly in rural productive areas, but stores were visited in both large and small urban areas in both countries, and although they were all fairly old buildings, such was their situation that one would have expected a maximum effort to achieve up-to-date efficiency in both refrigerating plant and commodity handling equipment.

● It would be unfair to generalize on visits to eight cold stores, and comment must be confined to actual experience, Mr. Milne and Mr. Mackenzie have told "M.R.", but it would be reasonable to say that refrigerating efficiency in Scotland appears to be in advance of anything they saw. Refrigerating plant in most cases was of somewhat ancient vintage and, although it doubtless fulfilled its appointed task due to the unflagging effort of the engineers, it could not be compared with the plant one expects to find and usually does find in British stores. Safety precautions were, in many cases, almost non-existent, and it would appear that we are years ahead in that respect. In only one store were mid-bar gates in use on hoists and in some cases hoist cages were open to the shaft on two sides, and landing gates, where they existed, were very unsafe.

● Mechanical handling was not, strangely enough, standard equipment and where it was in use it was accompanied by tremendous loss of space. One could assume that labour costs were so high that full space usage was of secondary importance but the haphazard approach to the problem created both surprise and disappointment. Many irregularly shaped packages were palletized and stows appeared unstable and in fact, in some cases, were supported by timber wedged between floor and roof. Cleanliness was not particularly marked and there was no evidence that the labour force was supplied with protective clothing of a standard pattern.

● Once again, it is necessary to stress the limited range of the visit, and therefore the limited value of any opinion expressed, but the conclusion drawn is that conditions, both for staffs and for customers in Scotland, can stand up to anything seen on this trip. One of the purposes of the visit was to compare the value of the services to the customer, and while it is almost impossible to relate charge to charge in dollars, as compared to pounds, there is no doubt that if Factory Act Regulations in force in Scotland were applied to the comparable cold stores visited, then very heavy capital expenditure would be immediately necessary. This would be accompanied, one assumes, by increased charges. Accurate comparisons of charges were made three or four years ago, as a result of a visit to a very modern and extremely large cold store on the Continent, and on that occasion the level of charge commodity for commodity was almost identical. It is felt that the same position exists to-day with regard to our opposite numbers in Canada and America.

Mr. W. A. P. Milne (second from left) and Mr. J. A. Mackenzie (fourth from left), enjoying curling with Canadian colleagues during their recent tour of North America.

NEWS OF THE MONTH

Refrigeration and A-c. Exports. — During October, 1958, air-conditioning and refrigerating machinery (commercial and industrial sizes) to the value of £645,878 weighing 937 tons, was exported from the United Kingdom. Comparable figures for October, 1957, were 1,134 tons, worth £775,579.

* * *

Exports' Analysis.—Of the 937 tons of air-conditioning and refrigerating plant worth £645,878 exported by Great Britain in October—quoted in the preceding paragraph—127 tons went to the Union of South Africa, 27 tons to India, 71 tons to Australia, 87 tons to New Zealand, 29 tons to Canada, 210 tons to "other Commonwealth countries," 39 tons to Eire, 13 tons to Sweden, 53 tons to Western Germany, 36 tons to the Netherlands, 32 tons to Belgium, 16 tons to France, 17 tons to Italy, and 180 tons to "other foreign countries."

* * *

Refrigeration Plant Classified.—Of the total exports of air-conditioning and refrigerating machinery during October, quoted in the first paragraph, commercial refrigerators accounted for 76 tons, worth £47,290, industrial plant and equipment for 292 tons, worth £162,776, and parts for all non-automatic refrigerating machinery, for 307 tons, worth £264,953.

* * *

Exports of Small Refrigerators.—During October, 1,256 tons of complete refrigerators (including complete mechanical units) were sent overseas from Great Britain. These exports were worth £818,677. The 1,256 tons comprised 141 tons to the Union of South Africa, 28 tons to Rhodesia and Nyasaland, 5 tons to India, 125 tons to New Zealand, 577 tons to "other Commonwealth countries," 3 tons to Sweden, 2 tons to Western Germany, 2 tons to the Netherlands, 54 tons to Belgium, 8 tons to Italy, and 312 tons to "other foreign countries."

* * *

Importation of Natural Gas.—The *Methane Pioneer*, the ship jointly owned by the Gas Council and Constock International Methane Limited and to be registered in the Port of London, is now fully converted to carry an experimental cargo of liquefied natural gas across the Atlantic and is about to undergo her trials in and around the Gulf of Mexico. The trials will last some three months, after which the ship will sail for the United Kingdom to deliver the first experimental cargo to the North Thames Gas Board at their Canvey Island marine terminal. The liquid natural gas will then be converted to gas under pressure and delivered by direct transmission line to the board's Romford works for reforming the town's gas and subsequent delivery to the board's consumers.

LIGHTFOOT-LINDE AGREEMENT

The Lightfoot Refrigeration Co., Ltd., of Wembley, Middlesex, England, and **Gesellschaft Fur Linde's Eismaschinen A.G.** of Wiesbaden, Germany, have signed an agreement for mutual collaboration whereby the full range of products and technical resources of each company in the field of domestic and industrial refrigeration and air-conditioning will be made available to the other.

Full details of any of the products within this range are being made available by The Lightfoot Refrigeration Co., Ltd., Abbeydale Road, North Circular Road, Wembley, Middlesex, and by Linde Refrigeration and Machinery Ltd., 47, Victoria Street, London, S.W.1.

Council House Refrigeration.—Redditch, Worcs., Urban Council, are to invite traders to submit tenders for the rental of refrigerators to tenants of council houses. The invitation follows protests to the council's estates committee by traders' representatives against a proposal by the council to purchase refrigerators in bulk from an outside firm and rent them at about 2s. 6d. a week. Mr. T. N. Haines, the West Midlands secretary of the National Chamber of Trade, told the committee that the proposal would mean the council would be going into unfair competition with traders already heavily burdened as taxpayers. It was stated that 3,000 tenants had been approached and asked if they would like refrigerators. Up to now over 1,000 had replied that they would.

* * *

Electrical Industry's Record.—Commenting on last month's announcement that the British electrical and allied manufacturing industry had been awarded 15 medals—an all-time record for the number of awards to any single exhibit at any international exhibition—for its exhibit in the British Pavilion at the 1958 Brussels World

Exhibition, Mr. David Maxwell Buist, M.I.E.E., export director of the British Electrical and Allied Manufacturers' Association, said : " Covering as the industry does a very great variety of activities and products from every kind of power generation, down to domestic electrical equipment, the industry naturally expected to receive some awards, but it was with feelings of pride and justification of their efforts over the past few years that those responsible for the industry's exhibit heard the news that they had received 15 awards."

* * *

Gas Appliance Sales.—With the exception of gas cookers, sales of appliances were higher in April to June, 1958, than in the corresponding quarter of 1957. Both cash and hire-purchase sales of cookers were down by 4 per cent. Gas space heater sales were 35 per cent. up and sales of water heaters rose by almost 13 per cent. Sales of wash boilers and washing machines were up by 1 per cent. but *sales of refrigerators increased by 188 per cent. from just under 6,000 to nearly 17,000.*

	3 months ended		Percentage change on corresponding period of previous year
	June, 1957	June, 1958	
Appliance Sales—Cash and Hire Purchase	(Thousands)		
Cookers	128·4	123·1	– 4·1
Space heaters—gas	12·7	17·1	+ 34·6
Water heaters ...	41·1	46·3	+ 12·7
Wash boilers and washing machines	57·5	58·2	+ 1·2
Refrigerators ...	5·9	17·0	+188·1

Refrigeration plant on a large scale is installed at the new £6,000,000 synthetic rubber plant, which was built in 16 months at Hythe, Hants., with a capacity of at least 70,000 tons. Now in full stream production, the plant, operated by The International Synthetic Rubber Co., Ltd., marks the establishment of a new British industry which can save the country $25,000,000 per year on imports of general purpose synthetic rubber. (*A description of the installation will appear next month.*)

★

PICTURE OF THE MONTH

★

AERO ENGINE TEST PLANT

LARGEST PRIVATELY-OWNED ESTABLISHMENT IN THE BRITISH COMMONWEALTH

IN no small measure has the pre-eminence of the British aircraft industry in post-war years been due to the outstanding design and performance of its aero engines. It is equally true that the continuing development of these power units has owed much to the high-altitude simulation testing equipment which refrigeration manufacturers have helped to provide.

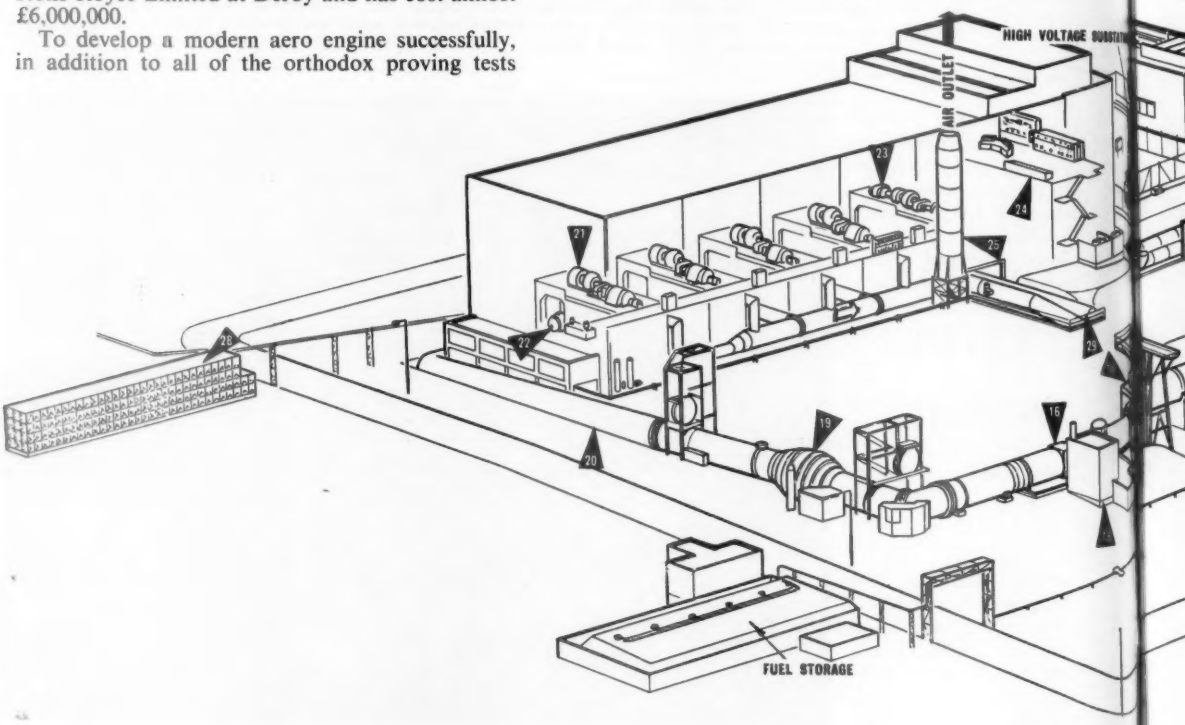
The largest privately-owned establishment in the British Commonwealth of this kind was recently officially opened by Mr. Harold Macmillan, M.P., the Prime Minister.

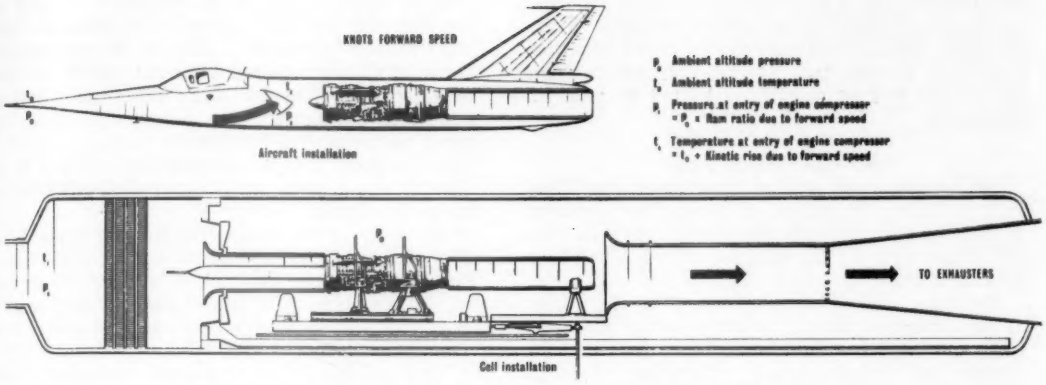
This new altitude test plant has been built by Rolls-Royce Limited at Derby and has cost almost £6,000,000.

To develop a modern aero engine successfully, in addition to all of the orthodox proving tests

Key to test circuit

1 Electrostatic air intake filters.
2 Input compressor.
3 Cooler for input compressor.
4 Refrigeration plant.
5 Recuperation turbine.
6 Cooling turbine.
7 Silencer for turbine exhaust.
8 Mixing box.
9 Cell intake pressure control valves.
10 Dynamometers.
11 Altitude test cell.
12 Preparation shop.
13 Diffuser duct.
14 Spray water pumphouse.
15 Primary cooler.
16 Cell pressure control valve.
17 Heat exchanger.
18 Primary cooler pumphouse.
19 Secondary cooler.
20 Main exhauster duct.
21 Exhauster compressor.
22 Cooler for exhauster compressor.
23 Recuperation turbine.
24 Main control room.
25 Main exhauster silencer.
26 Transformers.
27 Cooling water pumphouse.
28 Settling tanks.
29 Cross-over duct between input and exhauster buildings.
30 Compressor test rig.



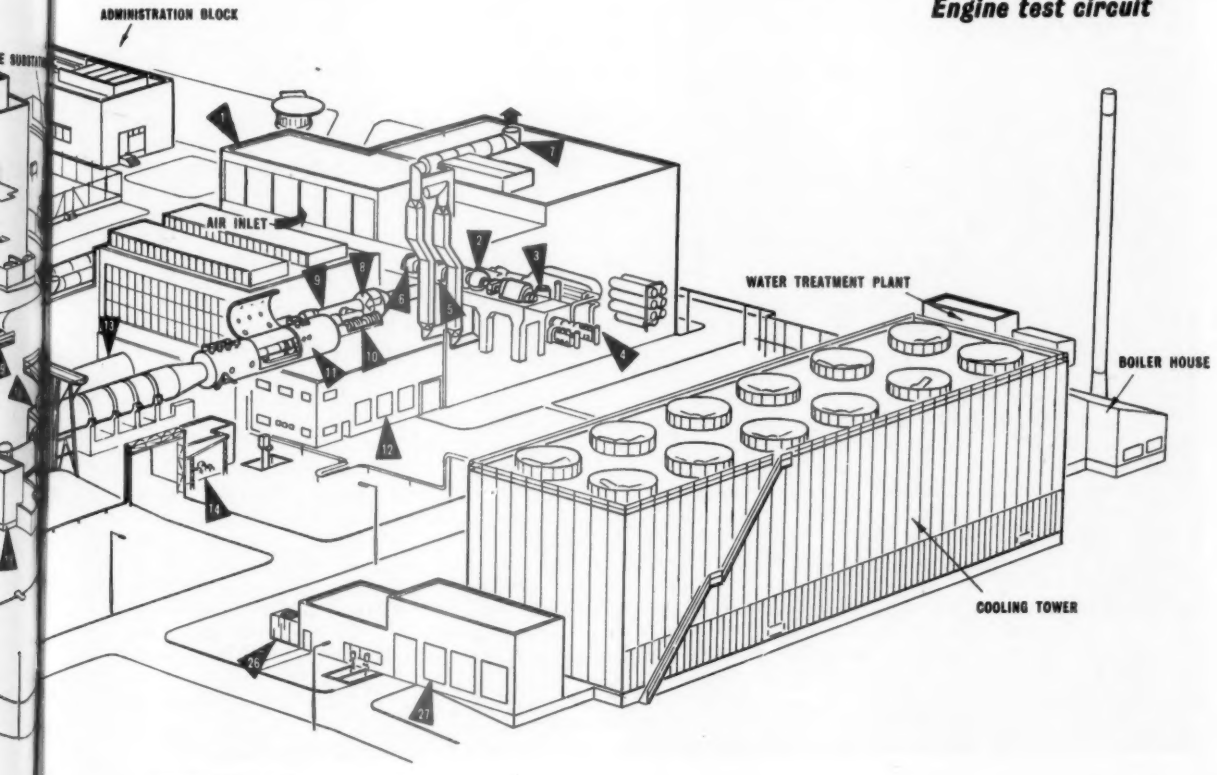


Aircraft and cell comparison (the cell is marked "11" in the diagram below).

designed to establish performance characteristics and mechanical reliability under sea level static conditions, it is most important to establish performance and characteristics at all operating altitudes and forward speeds as soon as possible. Other features such as, for example, anti-icing characteristics, combustion and reheat efficiencies, are equally important and the ideal would be the simulation of the complete flight plan.

Until recently, the only means for meeting these

Engine test circuit



requirements has been by the use of flying testbeds, in which the engines under test are installed. This, of course, suffers from the obvious drawbacks that a suitable aircraft may not be available in time and testing can be severely restricted by weather conditions.

The Rolls-Royce Plant

The altitude test facility, which has now been built at Derby, is capable of testing any turbo-jet or turbo-propeller engine envisaged within the next few years, over all the forecast civil and military aircraft altitude operating conditions.

The basic conception is to supply, at the intake of the test engine, treated air at the correct temperature and pressure conditions for any selected altitude and forward speed. The plant has been designed to supply engine intake pressures varying from 1 p.s.i.a. to 55 p.s.i.a. over a range of temperatures varying from −90° to +190° C. These are the conditions at the intake, the rest of the engine, including the exhaust or propelling nozzle, is subject to a pressure corresponding to any selected altitude to at least 70,000 ft.

The main components of the plant required to achieve these air conditions are enclosed in two large brick, concrete and steel structures, the input (air treatment) and the exhauster buildings. These are interconnected by large-diameter ductwork and exhaust gas coolers. Many ancillary services are situated on the 11-acre site, such as the cooling tower, water treatment plant, fuel storage, high-voltage sub-station, boilerhouse and administration block.

The power for driving the large electric motors is taken from the grid through an East Midlands Electricity Board sub-station to the Rolls-Royce sub-station on site, which transforms the power from 33,000 volts to the 11,000 volts required by the six 22,000-h.p. synchronous motors. Power for ancillary services is from a different source of supply at 6,600 volts.

The water required on the site for multifarious cooling duties and for domestic use is supplied from the town main to a 750,000-gal. reservoir under the main cooling tower, being passed through a water treatment plant on site.

The plant is designed for minimum operational supervision and automatic warnings and trips, where necessary, are incorporated to safeguard the machinery.

Atmospheric air is drawn through an electrostatic filter by the input compressor and is compressed to 55 p.s.i.a. at 190° C. This air, in the main, then passes through a water-cooled heat exchanger, an ammonia refrigerating plant, a water separator and, finally, a chemical drying plant. At this point it is completely dry and at a temperature of 8° C. This dry air can be passed through a control valve direct to the engine test cell or diverted through an expansion turbine to give temperatures down to −100° C. If temperatures above 8° C. are required, then the 190° C. air can be mixed with the former. Since there are no additional pre-heaters, this temperature gives the plant the upper limit of Mach number, which is approximately 2·5 at altitudes above 36,000 ft. The 55 p.s.i.a. pressure is more than adequate to cover this figure.

The duty of the main refrigeration plant is to cool air at the rate of 160 lb. per second, from a fully saturated condition at 29° C., and 54 lb. per sq. in. absolute to a temperature of between 2° and 3° C., at approximately the same pressure. The plant consists basically of two Sterne 3Z 14 × 12 ammonia compressors complete with capacity-reducing valves and automatic unloading valves arranged to be direct-coupled to auto-synchronous motors each of 400 h.p.

There are six unit shell and tube condensers in two stacks of three units, each stack being complete with an ammonia receiver.

The air coolers are of the shell and tube type, single pass, with tubes galvanized internally, being fitted in two stacks of two coolers, each stack being complete with an accumulator, float valve and back-pressure control valve. The operation of the plant is controlled from the main control room, from which room the number of compressors in operation and the capacity of each individual compressor can be varied. Although the plant can be arranged in such a way that the operation can be varied, normally, when on full load, one compressor is used for the first-stage cooling, and the other for the second-stage cooling of the air. In addition to the air-cooling plant, there is also a shell and tube brine cooling plant capable of cooling 500 gallons of brine per minute, which brine is used to cool, after they have been regenerated, the silica gel air driers.

There is also one other piece of equipment which Sterne's have supplied ; this is a portable plant mounted on a trailer and is capable of cooling 2,500 gal. of aero engine fuel from +20° to −55° C. (−67° F.) in 40 hours. The plant is a special compound " Arcton 4 " compressor with shell and tube condensers and evaporators, fuel circulation pump, etc., all this equipment being mounted on trailer.

A recuperating turbine is coupled direct on to the input air compressor so that air surplus to engine requirements can be passed through this turbine and the power recovered. In the same way the expansion turbine is also connected direct to the input compressor and, when in use, gives back power to the same shaft.

The input compressor supply can be augmented or replaced by air from the exhauster building or by direct suction from atmosphere.

Having mixed the air to the required temperature, it can be fed to No. 1 cell or No. 2 cell, or the compressor test rig. There is included a by-pass circuit which is common to both cells and is necessary for control during engine accelerations.

High-altitude Cells

The high-altitude cells are divided into two compartments :—

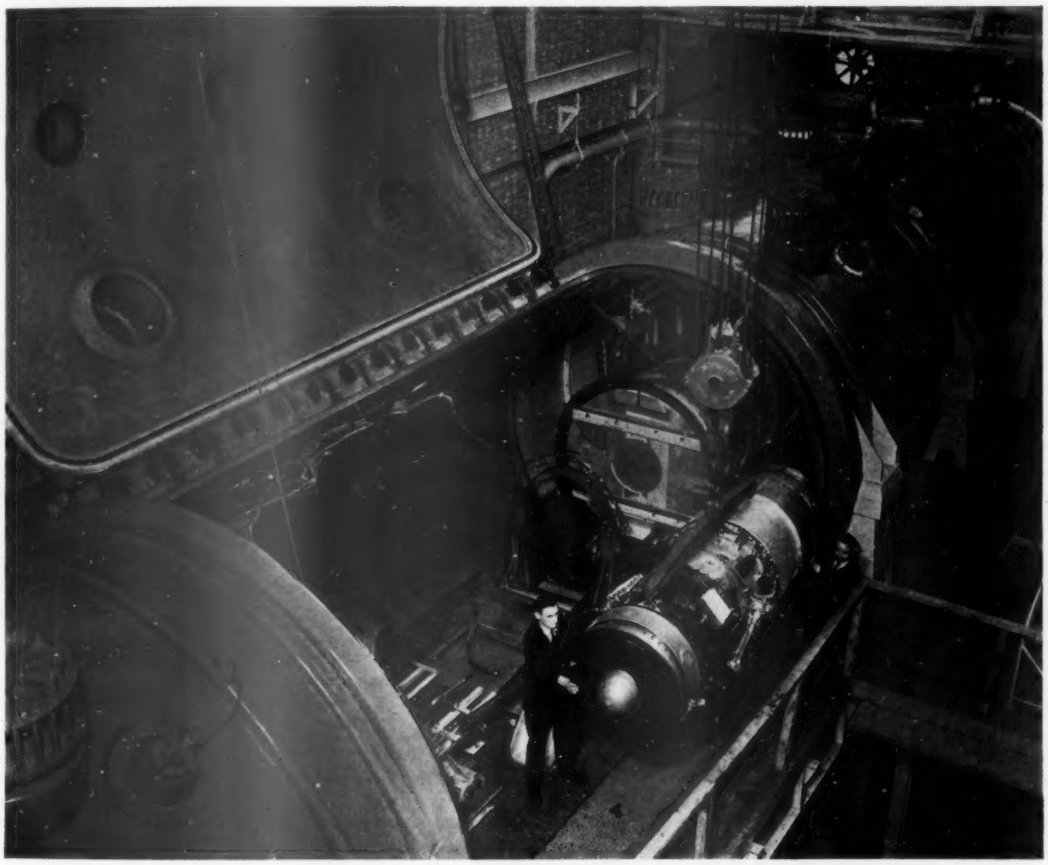
(1) The plenum chamber, and
(2) the cell proper.

The air at the correct temperature and pressure is fed to the plenum chamber, which contains air straighteners, gauze debris screen, and pressure and temperature measuring instruments. The cell proper is separated from the plenum chamber by a bulkhead through which is inserted a calibrated airmeter connected direct to the engine, which lies in the cell proper. Because of the low temperatures to which the ductwork from the cooling turbine to the bulkhead is subject, the whole of this portion has been constructed in stainless steel.

The engine is mounted on a floating cradle connected to a weighing machine for thrust measurement. This portion of the cell also carries a water-cooled tube through which passes the engine exhaust. Whilst both cells are constructed in this general fashion, cell No. 1 is only capable of testing turbo-jet engines, but cell No. 2, being provided with a dynamometer, is also able to test turbo-propellers. To this end the input air to cell No. 2 is fed into the side of the plenum chamber in order to leave space for the shaft connecting the engine propeller shaft to the dynamometer.

Particular attention has been paid to the preparation, instrumentation and general handling of engine changeover, in order to economize on the time required between tests. The engine is mounted on a " dolly " in a preparation room. This dolly is a transportable part of the cradle and carries

Engine being loaded into test cell.



battery plates for manometer and electrical connexions. The connecting of the engine tappings to these battery plates is carried out in the preparation room and then the engine, mounted on its dolly, is transported to the cell compartment. Here the assembly is bolted to the floating cradle and the battery plate is connected to the permanent cell instrument lines.

Access to the cell for this purpose is through a large hinged door which extends for 20 ft. of the length of the cell and weighs 16 tons. This, when closed, forms part of the cylindrical skin of the cell. An airlock entrance is also provided for personnel and comparatively small objects. The engine exhaust is discharged into the open end of the water-cooled duct which, as mentioned, protrudes into the cell and is exhausted through the primary and secondary coolers to the exhaust compressors. Water spray nozzles are fitted in this duct to form a safety curtain against possible explosion and the duct itself is so designed that some pressure recovery is obtained to assist the exhausters and thus extend their capacity.

At the rear end of each cell the ductwork leaves the input building and continues in the open air. Up to the primary cooler, a distance of 143 ft., it is water-jacketed and in this length is a removable section which can be replaced by a solid bulkhead. Since only one primary cooler and one secondary cooler have been provided, the ductwork from the two cells joins in a Y-piece just upstream of the primary cooler. The solid bulkhead is placed in the ductwork of the cell which is not in use and thus renders that leg safe for work on the installation of an engine whilst testing is being carried out in the other cell.

The primary cooler is virtually a six-drum water-tube boiler, pressurized with nitrogen to 250 p.s.i. The chemically pure water which it contains is pumped in a closed circuit through a heat exchanger, which in turn is cooled by water from the main circulating water system. The cooler is designed to deal with exhaust gases up to 1,730° C., cooling them down to below 150° C.

In the ductwork between the primary and secondary coolers is a large multi-vane butterfly valve, which controls the pressure of the air surrounding the engine in the cell.

On leaving the primary cooler, the products of combustion pass on to a secondary cooler which consists of four matrix-type elements through which water from the main cooling-water system circulates. This secondary cooler reduces the temperature of the gases to below 70° C., thus making them acceptable to the exhausters. The water from the sprays, mentioned previously, condenses in this cooler and is extracted. From the secondary cooler the main duct continues for 370 ft. round the back of the exhauster building and along its north wall to the five exhauster compressors.

Control

Control of the air circuit is carried out from three places—the main control room, engine test control and compressor test control room.

The main control room is the nerve centre of the whole plant and here the main air circuit to suit the test required is set up, the main compressor sets started and all auxiliaries such as refrigerators, driers, hydraulic pumps and electrostatic filters are started and supervised. Air circuits are selected by the introduction of the appropriate template into a plate desk and a mimic diagram gives a visual indication of lines in use and valve functions. In this room are housed the controller and his deputy, and the charge engineer. The controller is responsible for setting up the circuit and monitoring during the whole of the test run. He is responsible, at all times, for the safety of the main plant. The starting of the motors and auxiliaries is the responsibility of the charge engineer, who works under the supervision of the controller.

The engine test control room accommodates the engine testing staff and an assistant controller, working together as a team. The former run the engine under test and the latter provides air to the engine at the temperatures and pressures required by the engine test schedu'e.

Complete instrumentation for engine testing is housed in this section, records being obtained photographically. In adjacent rooms, instrument service and electronic recording are provided.

The assistant controller is in direct communication with the controller in the main control room. He can operate only after a permissive switch has been turned by the controller.

In the compressor test control room, there is a similar arrangement to that in the engine test control room, except that the assistant controller's main duty is to drive the air turbine and maintain the speeds required for the test.

Air Circuit

The interconnexions of the air circuit are achieved by valves of various types. The isolating valves are, in almost every case, electrically operated from the main control room by push-button. In the case where rapid movement is required, hydraulic rams are used instead of electric motors. These are also operated from the main control room by push-button.

The valves controlling temperatures and pressures in the circuit and the correct functioning of the compressors are all hydraulically powered and, when subject to automatic working, are actuated via magnetic amplifiers operating from signals

received from pressure and temperature sensing points. The magnetic amplifiers compare these signals against manually set valves, any out of balance causing movement of the main valve until the error is cancelled. Thus, pressures and temperatures are held automatically, the desired settings having been previously set by the assistant controller. The automatic control is taken a step further on another desk, where the desired settings can be varied to a programme, enabling an engine under test to be subjected to all the variations met in a complete flight plan.

Manual operation of all the control valves can be carried out by switches on both the assistant controller's and controller's desks.

Anti-surge

To avoid damage, the compressors must be prevented from surging and a method has been devised which utilizes a recirculation valve connecting the discharge and suction sides of all compressors. Should the pressure ratio rise towards the surge value, an instrument has been provided which measures the pressure ratio, compares this with a preset maximum, and opens the by-pass valve at a safe margin from the surge point.

Main characteristics and dimensions of plant :—

1. DRIVING MOTORS FOR ALL COMPRESSORS
   22,000 h.p.
   50 c.p.s. synchronous
   11,000 volts
   1,500 r.p.m.

2. LARGE COMPRESSORS
   Eleven-stage axial flow
   4,150 r.p.m.
   3·8 to 1 pressure ratio
   200 lb./sec. mass flow with atmospheric inlet

3. SMALL COMPRESSOR
   Ten-stage axial flow
   7,720 r.p.m.
   3·8 to 1 pressure ratio
   68 lb./sec. mass flow with atmospheric inlet

4. AIR-COOLING TURBINE
   Two wheel single stage
   4,150 r.p.m.
   160 lb./sec. mass flow
   Minimum outlet temperature −104° C.

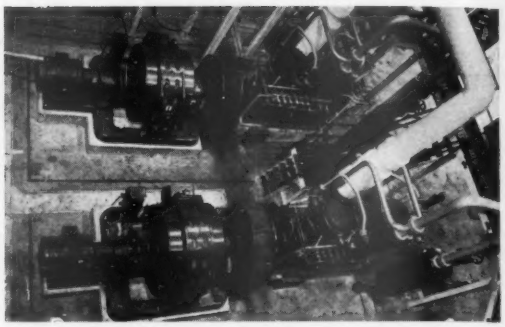
5. INPUT RECUPERATING TURBINE
   Two wheel single stage
   4,150 r.p.m.
   154 lb./sec. mass flow

6. RECUPERATING TURBINE IN HIGH-PRESSURE AIR CIRCUIT
   Two wheel single stage
   7,720 r.p.m.
   181 lb./sec. mass flow at 155 p.s.i.a.
   57 lb./sec. mass flow at 48·5 p.s.i.a.

7. TURBINE FOR COMPRESSOR TEST RIG
   Two wheel single stage
   15,000 h.p. at 9,000 r.p.m. with inlet pressure of 155 p.s.i.a.
   3,000 h.p. at 7,720 r.p.m. with inlet pressure of 48·5 p.s.i.a.
   3,000 to 11,000 r.p.m. speed range
   Speed control to ±0·05 per cent.

8. CIRCULATING WATER PUMPS
   Double-entry centrifugal
   975 r.p.m.
   10,000 g.p.m. against 90-ft. head

9. PRECIPITRON ELECTROSTATIC FILTERS
   Capacity : Input 160,000 c.f.m.
   Exhauster 320,000 c.f.m.
   Compressor test rig 224,000 c.f.m.



The refrigeration plant.

10. REFRIGERATING PLANT
    160 lb./sec. of air from 29° C to 2° C.
    Cooling water : 2,400 gal./min.
    Charge of ammonia : 20,000 lb.

11. AIR-DRYING PLANT
    Capacity : 160 lb./sec. saturated air at 55 p.s.i.a. and 2° C. dried so that no ice is formed when air is cooled to −112° C. at 0·9 p.s.i.a.
    Absorbers ° Four in number, each containing 16,000 lb. of drying agent
    Reactivation by heated air at 188° C. Subsequent cooling by water, followed by brine, down to 2° C.

12. PRIMARY COOLER
    Six-drum water tube cooler pressurized to 250 p.s.i.a. with nitrogen
    Thermal capacity : cools 105 lb./sec. of dry air at 5 p.s.i.a. from 1,730° C. to 107° C.

13. SECONDARY COOLER
    Four in number matrices
    Thermal capacity : 105 lb./sec. of dry air at 3·3 p.s.i.a. from 107° C. to 40° C.

14. WATER TREATMENT PLANT
    Treats 71,300 gal./hr. of water of total hardness 64 p.p.m. $CaCo_3$ and reduces it to 3 p.p.m. $CaCO_3$

15. COOLING TOWER
    1,800,000 gal./hr. (as for water treatment plant)
    Heat dissipation 504 × 10^6 B.t.u./hr.

16. PERMISSIBLE POWER CONSUMPTION
    For main compressor motors at 11,000 volts the maximum permissible power is 60 megawatts. This is ample for every purpose envisaged at present.

Responsibilities :

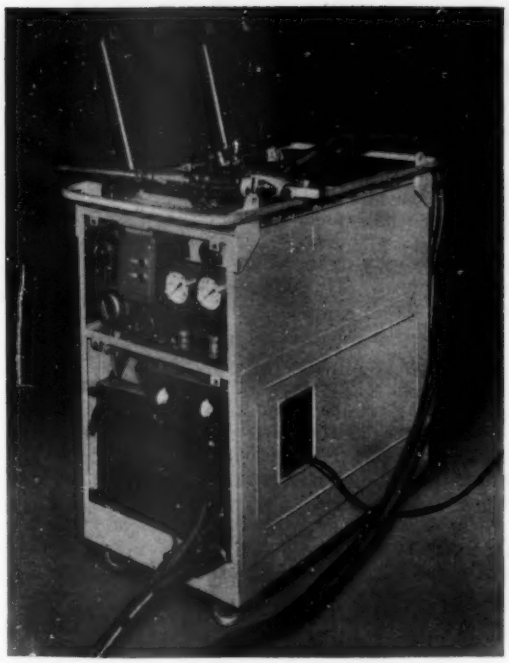
Consulting engineers : McLellan & Partners in association with Merz & McLellan.
Consulting civil engineers : R. T. James & Partners.
Architects : Ramsey, Murray, White & Ward.
Civil engineering : Gee, Walker & Slater Ltd.
Compressors and turbine sets : British Brown Boveri Ltd.
Refrigeration plant : L. Sterne & Co., Ltd.
Ducting and pressure vessels : G. A. Harvey (London) Ltd.
Insulation : Newalls Insulation Co. Ltd.
Control of air systems : Foxboro-Yoxall Ltd.
Cooling tower : Head Wrightson Processes Ltd.
Air valves : Johannes Erhard H. Waldenmair Erben.
Switchgear : A. Reyrolle & Co. Ltd.
Electrostatic filtration plant : Sturtevant Engineering Co. Ltd.
Chemical air-drying plant : Silica Gel Ltd.

RIGID FOAM INSULATED DOOR

SINCE its introduction in January, 1958, the " Millex 157 " rigid foam insulated door has been well received by naval architects and marine engineers, " M.R." learns on good authority.

" Millex 157 " is the trade name given to the insulation material manufactured by Miller Insulation and Engineering Ltd., of Glasgow. It is a rigid foamed resin of low thermal conductivity and remarkable strength, prepared from an isocyanate resin produced by Imperial Chemical Industries Ltd.

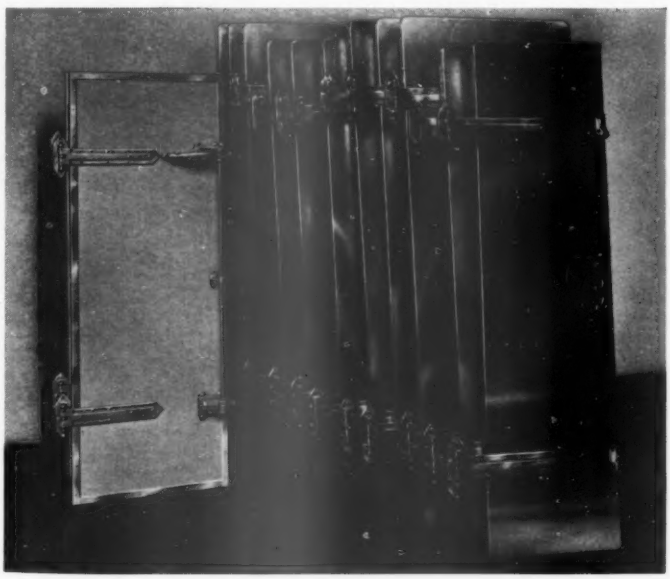
After considerable research and experimental work Miller Insulation and Engineering Ltd. can offer an insulation material which, at present, although basically more expensive than traditional materials, can be applied more cheaply overall. They have also developed a continuous flow machine for void filling on ship or site which also helps to cut down on actual construction costs. Initially this material was used only in the construction of " Millex 157 " rigid foam insulated doors but as its practical application potential is unlimited, the next logical step is its use in the construction of insulated stores and storage spaces.



A "Millex 157" rigid foam insulated door is one-third the weight of a traditionally insulated door of the same dimensions.

The heat leakage of a " Millex 157 " door is 0·05 B.t.u. per ° F.

Miller Insulation and Engineering Ltd., of Northinch Street, Glasgow, W.4, now offer rigid foam insulated doors designed and constructed to stringent specifications.



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Above: Prototype of machine developed for mixing " Millex 157 " on site.

Left: A series of " Millex 157 " rigid foam insulated doors ready for dispatch.

CONTROL OF HIGH VELOCITY, DUAL DUCT, AIR-CONDITIONING SYSTEMS*

HIGH Velocity Dual Duct is the name given to a system of air-conditioning whereby cool air and warm air are separately ducted at high velocity to individual mixing units located in the rooms. The advantages claimed for the system are that :—

(1) The system provides individual temperature requirements automatically controlled in all rooms.

(2) To effect (1) heating of some rooms and cooling of others can be done simultaneously.

(3) All the conditioning apparatus is centrally located, simplifying operation and maintenance, and eliminating water piping and wiring to the conditioned spaces.

It will readily be appreciated that in order to attain the benefits claimed for the system, accuracy and reliability of the automatic controls are of prime importance.

Control of Mixing Units

To obtain satisfactory operation of these units under all conditions it is essential to maintain constant the volume of air emitted by the unit, and to this end Drayton have developed a pneumatically operated *differential pressure* regulator which measures the differential pressure across the outlet grill. Compressed air at 15 p.s.i. is fed to the controller and dependent on the differential pressure being measured, the controller applies pressures of 0–15 p.s.i. to a *thruster unit* which positions the air inlet damper or dampers to maintain the differential pressure and consequently the air volume constant.

A room thermostat, which can be mounted in the conditioned space or inside the mixing unit in the stream of induced recirculated air, maintains the temperature constant. Compressed air at 15 p.s.i. is supplied to the thermostat which applies pressures variable between 0 and 15 p.s.i. to a thruster unit similar to that operated by the differential pressure controller. This positions the air inlet dampers.

In one type of mixing unit the differential pressure controller, through its thruster unit, opens and closes the cool air damper directly while the thermostat, through its thruster unit, directly operates the warm air damper. This method is shown diagrammatically in fig. 1.

Another type of unit utilizes coupled dampers and linkage and here the thermostat through its thruster unit moves both dampers in such a direction as to admit less warm and more cool air on a rise in temperature and vice versa on a fall in temperature. The differential pressure controller, through its thruster unit, maintains the

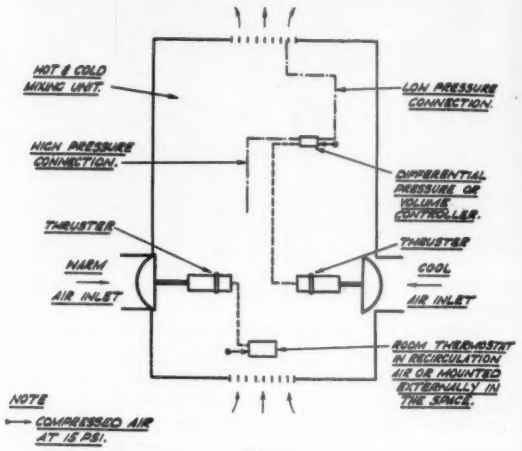


Fig. 1.

volume constant by opening or closing both dampers without altering the proportions of hot and cool air admitted. This arrangement is shown diagrammatically in fig. 2.

Control of the Central Plant

One type of typical plant is shown diagrammatically in fig. 5. The fresh air damper is arranged with a stop so that the minimum fresh air design conditions are met. The exhaust damper is normally closed and recirculation damper normally open.

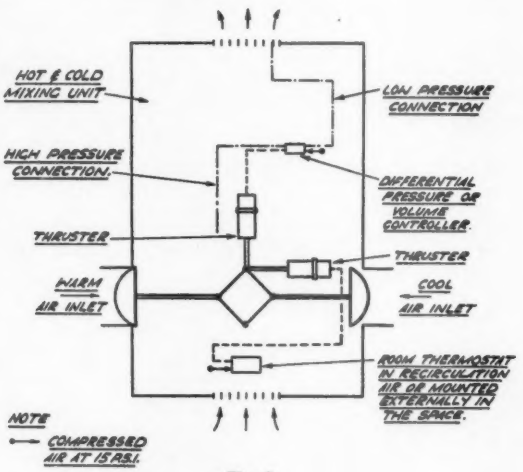


Fig. 2.

Duct thermostat, T1, in the fresh air intake resets the control point of submaster thermostat, T2, so that for the minimum fresh air temperature, T2 controls at the maximum design temperature. As the fresh air temperature rises, T2 is reset downwards to a minimum temperature a few degrees above the average desired room temperature.

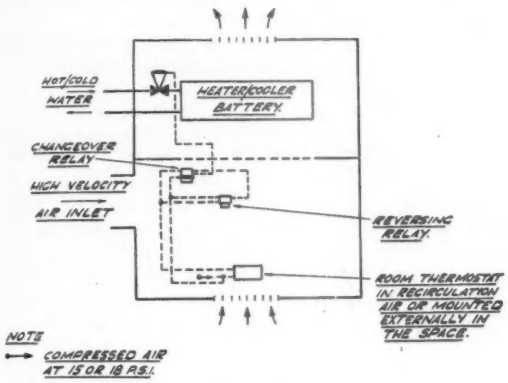


Fig. 3.

T2 controls the heater and because of the wide load involved it is recommended that two valves V1 and V2 are used, sized for $\frac{1}{3}$ and $\frac{2}{3}$ full load respectively and operated sequentially.

Thermostat T3 controls the cool air duct at, say, 50° F. On rising temperature, pressure switch P starts the spray water pump. On further rise in temperature, T3 operates damper motors M1 and M2 through relay R to open the fresh air and exhaust dampers and close the recirculation damper. Further rise in temperature causes relay R to close the fresh air to minimum, close exhaust and open recirculation. If the temperature continues to rise the thermostat then opens the three-way valve V4 to admit more chilled water and less recirculation to the sprays.

Humidistat H, in the recirculation duct, controls the valve V3 on the sprays in the warm duct.

Variations of this scheme can be used. For example, T3 can be made the submaster thermostat reset upwards by T1 during winter conditions with economy in the heater load of the warm air duct. If desired, the fresh air duct damper motor can be arranged to shut completely when the fan is shut off, while a preset minimum opening is maintained when working.

It should be noted that the above plant, having no reheat in the warm duct, cannot necessarily maintain humidity conditions during periods of light sensible heat load.

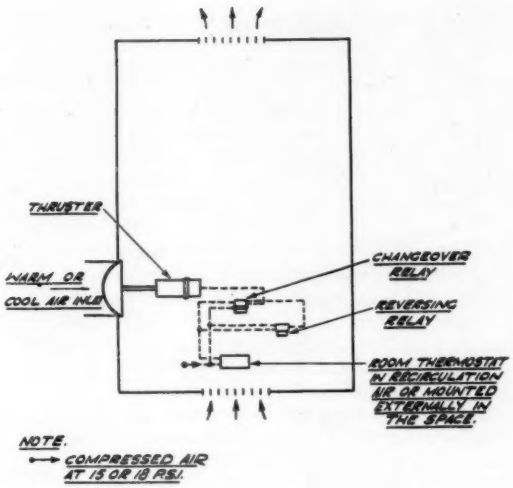


Fig. 4.

CONTROL OF SINGLE DUCT INDUCTION UNITS

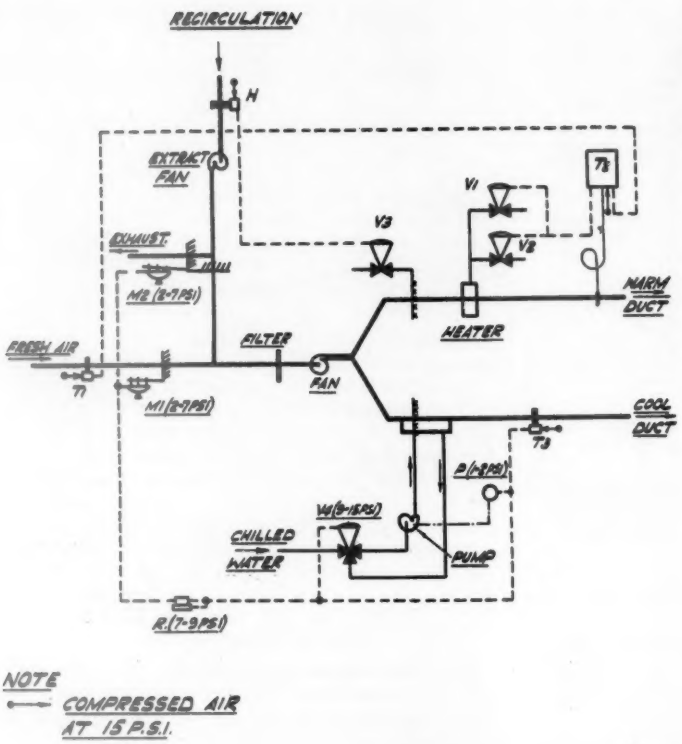
For convenience some mention is made here also of the control of the single duct systems.

Two types are considered, those with built in heater/cooler and the type which has no heater/cooler and is essentially a sound attenuator and diffuser unit.

Fig. 3 shows in diagram form a unit with a heater/cooler battery. The thermostat controls a diaphragm valve on the water supply. In winter when heating is required this control is direct but in summer when the action of the thermostat must be reversed, a changeover relay is operated to bring into circuit a reversing relay.

Under winter conditions, hot water is supplied to the battery and a rise in temperature at the thermostat produces an increase in air pressure to close the valve. In summer when chilled water is supplied to the battery, a rise in temperature at the thermostat, causing a rise in pressure output, is reversed in the reversing relay into a proportionate fall in pressure output. This fall in pressure now applied to the valve through the changeover relay causes the valve to open.

Operation of the changeover relay is effected by changing the operating air supply from 15 p.s.i. to 18 p.s.i. This change in air pressure can be made manually or automatically from the control station. It is made simultaneously with the changeover from heating water supply to cooling water supply.



A simple duct unit as shown in fig. 4 can only have limited control applied to it. Restriction of the air supply beyond a limited amount would reduce the air change below design values. Because seasonal changes require warm or cool air to be supplied the action of the thermostat must be reversed as explained above.

Stops on the thruster unit enable the maximum reduction of air flow to be adjusted.

*Notes from The Drayton Regulator & Instrument Co. Ltd , West Drayton, Middx.

☆

Fig. 5.

AIR-CONDITIONING LARGE BUILDINGS

BECAUSE of the depth of supporting beams in large buildings, one is accustomed to seeing a between-floor separation of at least 2 to 3 ft. In the past few years, however, buildings are appearing with a between-floor separation of only a few inches. This is made possible by the use of a central building core which provides lateral bracing for lightweight aluminium wall panels, states The Trane Company, Wisconsin.

A narrow floor separation can create a number of air-conditioning problems. An example of these problems and how they were overcome may be found in considering the Fidelity National Building, Oklahoma City.

The 17-storey Fidelity Building has a flat slab between floors that measures only 8 in. from the ceiling of one level to the floor of the next. This, plus other factors, combined to determine the design of a rather unique air-conditioning system.

The owner required individual room control in the perimeter zone with a separate interior zone.

Specific restrictions on system design included :—

(1) Denial of equipment room space on the second through 17th floors.
(2) Lack of space for horizontal duct or pipe runs to perimeter zone because of low 9 ft. 9 in. floor-to-floor height.
(3) Prohibition of outside wall penetration for relief or supply of outside air from the second through 17th floors.
(4) Provision for future movement of interior partitions without revision of mechanical system.
(5) The desire to use basement space for offices, tenant storage and file rooms.

A most economical selection of refrigeration equipment was made by selecting it in the preliminary design stages and using the capacity of this equipment to determine the size of the building windows.

A Trane "CenTraVac" hermetic, centrifugal

compressor, boiler, circulating pumps, air handling equipment, domestic hot-water heater and drinking water chiller were all placed in a penthouse above the 17th floor.

Supply ducts and warm and chilled water piping to perimeter zone units have traditionally been located in interior shafts, because steel beams supporting the customary heavy masonry walls restrict their passage up or down inside exterior walls. In this case, however, the lightweight aluminium and porcelain enamel exterior walls did not require the support of these spandrel beams. As a result, the supply air and piping radiate out from the penthouse, over the 17th floor ceiling and down outboard of the columns, just inside the metal skin walls, where they are convenient for connexion to perimeter air-conditioning units.

Approximately 1,000 Trane induction UniTrane units serve the perimeter offices. They are located on a module between each mullion which allows future movement of partitions without revision of the mechanical system. The induction units are hidden behind wooden panelling or metal wall-to-wall enclosures which blend with each office décor. Each office has its own thermostatic controls.

The interior zone is served by four high-pressure risers dropping down the centre core. At each floor, each quarter of the building is served by a pressure-reducing valve and a short run of horizontal low-pressure ductwork. Each quarter is identical on the fourth through the 17th floors. A return air fan is used to return all the air to a pressurized fan room in the penthouse where the two primary air fan units and the one interior zone high-pressure unit take return air as the season dictates. Unused return air is relieved from the penthouse to prevent excessive pressure in the occupied space.

The Fidelity National Building and its air-conditioning system were designed by Sorey, Hill and Sorey, architect-engineers. The air-conditioning equipment was installed by the Wattie Wolfe Company. Both firms are located in Oklahoma City.

Prestcold Acquires Midlands Refrigeration Firm

INDUSTRY news of considerable importance is that control of the well-known midlands firm of Refrigeration (Birmingham) Limited has been acquired by Pressed Steel Company Limited, Oxford.

Refrigeration (Birmingham) Limited have been in existence as a company for over 21 years and since 1943 have held a franchise as distributors of Prestcold refrigeration equipment, which is manufactured and marketed by the Prestcold Division of Pressed Steel Company Limited, and they will continue to operate in this type of business. Their territory is large and in general terms covers Warwickshire, Worcestershire, Leicestershire, Staffordshire and a portion of South Cheshire. Throughout this area they handle a very considerable volume of business covering both domestic refrigerators and those used for a variety of commercial applications. In addition to households, many industries, hospitals, schools, farms, retail stores and shops and other establishments have been Prestcold-equipped by them. The arrangement covers the extensive and well-equipped Amara works of Refrigeration (Birmingham) Limited at Bromford Lane, and the very fine new showrooms at Smithfield House, Digbeth. Opened at the beginning of this year, these showrooms are claimed to be the biggest and most modern in the midlands devoted exclusively to refrigeration products; they are situated close to the centre of the city and near to the meat and other markets.

The Birmingham premises of Refrigeration (Birmingham) Ltd.

The firm also has branches at Coventry, Leicester and Stoke-on-Trent and each of these is equipped with showrooms and service depots.

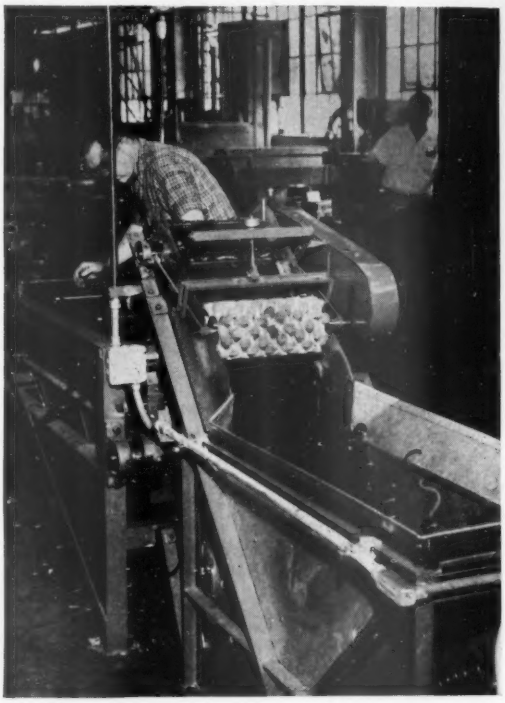
Refrigeration (Birmingham) Limited will continue to operate as at present under Mr. D. A. Field, managing director, and the other existing executives and staff. Its function as one of the most important organizations in the midlands marketing refrigeration equipment and providing service for it will similarly continue unchanged.

NEW INDUSTRIAL PROCESS

"Quick-freeze" technique is widely used nowadays in chemical processing, food packaging and in numerous other industrial and research fields. Currently it is also used to remove "flash," the very thin excess material that clings to soft-rubber and plastic moulds. Removal of this "overflow" is costly, often involving hand filling or abrasive-belt finishing.

"Quick-freezing" is a new "deflashing" system used by the American Garlock Packing Co. By this method, parts are being "quick frozen" by the expansion of carbon dioxide—sudden changes in temperature to near −90° F.—and then by tumbling the moulds against each other in six-sided revolving barrels. The bumping of the moulds strips off the excess material without harming the product.

Rubber and Plastic Moulds Cleaned by "Quick-Freeze" Process



THE Garlock Packing Company in the United States manufactures thousands of different types of packings, seals and gaskets for nearly every industrial operation. Many of these products and components of others are small moulded rubber sealing elements of assorted shapes turned out by the millions in banks of moulding machines.

One of the problems inherent in the production of such large quantities of moulded parts is the removal of "flash" or the paper-thin excess overflow material from the inside and outside diameters of the products which clings to soft rubber and plastic moul This has traditionally been a hand operation performed in a variety of ways ranging from hand punch dies to hand filing and abrasive belts. Recently, the Garlock Company began using a new flash removal process, actually a tumbling process whereby the rubber parts are quick frozen by the expansion of liquid carbon dioxide. Prior to the use of liquid CO_2, company engineers tried tumbling dry ice particles with the moulded rubber compound parts, but this method was soon discarded as inefficient and costly for the results obtained.

The present operation entails carefully controlled freezing of the product which has the excess mould flash attached to it. Temperatures are dropped in a matter of seconds from room temperature to 70 to 90 degrees below zero. The tumbling cycle is a precise operation with each type of part tumbled for its own given period of time lest product damage result. Steel jacks are tumbled with the parts where an excessive flash is present.

Tumbling equipment used is manufactured by Tumb-L-Matic, Inc. These barrels are insulated and are six-sided. There is no pressure present in the barrel, each being vented to allow free escape of the gaseous CO_2. Liquid carbon dioxide is delivered by tank truck and pumped to the main

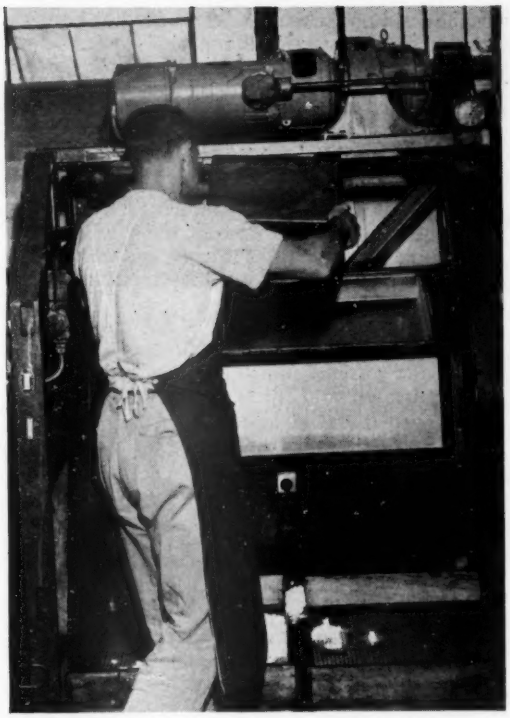
tank (manufactured by the Pure Carbonic Company, Division of Air Reduction Company). The main tank holds about six tons of liquid carbon dioxide at an approximate pressure of 285 p.s.i. A ¾ h.p. refrigeration unit keeps the main tank temperature somewhat below room temperature so as to avoid too high a tank pressure. The main tank is insulated and fitted with refrigeration coils.

The tumbling barrels are equipped with removable baffles; however, most of the tumbling work is done without baffles since most of the parts are too delicate. Steel jacks are used primarily when tumbling tough compounds such as GRS and natural rubbers.

The tumblers have variable speed and temperature controls. Temperature controls are necessary because the time of tumbling varies with the hardness or durometer of the compounds. Softer compounds generally are more difficult to tumble than harder materials. Hycars and Thiokols are examples of compounds that must be carefully handled because they tend to chip easily at the low temperatures used.

Generally any part that can be put into the barrels can be tumbled. Load sizes vary from 150 rings of 12 in. to 13 in. diameter per charge to 40,000 small (1 in. diameter) rings per charge; cycle time varies with the load and flash thickness. Average individual diameters of parts tumbled range from ⅜ in. to 5 in. although larger sizes can be accommodated.

Examples of the operation's efficiency present a remarkable contrast. The 40,000 small rings mentioned above, for instance, would by the old hand method of "deflashing," take 120 hours of an operator's time. The present process represents half an hour. Removing by hand method the O.D. flash from a small valve disc proceeded at approximately 1,200 pieces per hour, while I.D. deflashing was done at about 800 per hour. On a 10,000 piece valve disc order, a total of ten hours was expended just on removing flash. By the quick-freeze method, this job is completely deflashed in half an hour.



Silicone rubber parts are the only high volume products that are not tumbled. This is so because the lowest liquid CO_2 temperature available is not low enough to freeze the versatile silicone or even to affect its flexibility characteristics.

FIRE IN COLD STORES

FEW people in the trade will be sceptical about fire risks—the memory of Smithfield is too fresh. Modern fire fighting is so efficient that if damage amounting to £1½ million can be done with the London Fire Brigade in full attendance, as was the case at Smithfield, then the hazards involved must be taken seriously.

In point of fact, the Smithfield Poultry Market had many combustible elements in its construction : the roof was of slate on timber boarding, the floor on ground level was covered with wood blocks 3 in. thick, and timber was included in the composition of many of the partitions. Moreover, the thermal insulation of the compartments in the basements included various combustible materials—granulated cork, slab cork, slag wool, timber studding and matchboarding.

What added to the difficulty of fighting the fire

was the acrid smoke that was caused by the burning carcases and cases of poultry and game in the basement of the market, where the trouble started. This trouble was aggravated by restricted ventilation, and in fact the fire brigade tried in vain for 24 hours to find the seat of the fire.

A full day after the fire began the climax came when the flames burst through the ground floor of the building. Inflammable gases from the refrigeration equipment in the basement quickly filled the whole building, and all the firemen had to be withdrawn. In a matter of minutes, flames were leaping to a height of 100 ft.

The Smithfield tragedy (this is not too strong a word, for it cost the lives of two firemen) underlines heavily the extreme difficulties that may arise in fighting fires on cold storage premises.

It is even more imperative here than normally to stop fires right at the outset, and for this purpose a plentiful supply of portable fire extinguishers is essential. " Portable extinguishers are the minimum equipment for fire fighting. They should be provided in adequate numbers throughout the premises." No one would dispute this statement, made by the authoritative Fire Protection Association.

A guide to " adequate numbers " is as follows : fire points should be set up throughout the premises, not more than 50 ft. apart, and each fire point should consist of at least two modern portable extinguishers.

An equally important principle is that combustible material should be as far as possible excluded. The bulk of such material normally found is involved with insulation arrangements. Insulating materials such as cork slabs, granulated cork, charcoal, sawdust and the new foamed plastics and synthetic rubber are combustible, and most of them give off dense smoke. Covering the insulation with matchboarding, fibreboard or plywood, or mounting timber battens on its surface to give protection against mechanical damage adds further to the accumulation of combustible material. The hazard is increased, too, if there is a concealed space between the insulation and the wall, ceiling or roof.

Combustible outer coverings and concealed spaces, it is true, are usually found in older buildings. The tendency in more modern warehouses is to fit cork slabs or other insulating material directly to the surface of the wall or ceiling, cover this with cement or sand, and then finish off with a skin coat of special plaster. If this method is used to protect the insulation against ignition and to restrict the air supply, the fire hazard will be considerably reduced.

Again, old buildings are likely to present more difficulties than new ones because of such constructional features as timber floors, combustible roof construction and suspended ceilings. These not only add fuel to the fire, but allow it to spread.

But even in newer buildings of non-combustible construction, reasonable fire-resistance between compartments is often greatly reduced by openings for ducts and pipes : those that carry the cold air or the coolant to the storage compartments may be a means of spreading fire—especially air ducts made of plywood and timber studding, which are themselves combustible. Ducting, then, should be proof against the entry of fire, and openings where it passes through walls or floors must be made good to the same standard of fire resistance as the walls and floors themselves. Dampers which may be operated by gravity and released by thermostats or fuses can be recommended.

There are two further difficulties that may be involved (and in fact they were primarily responsible for the gravity of the Smithfield Market fire). Firstly, the fact that apart from the pipes and ducts the storage compartments are otherwise sealed means that the air supply may not be sufficient to support free burning, and the result may be a slow burning, smouldering fire producing thick smoke and poisonous carbon monoxide which have little opportunity to escape.

Secondly, firemen may be further hampered by ammonia escaping from the refrigeration plant. Ammonia is not only extremely toxic, but inflammable in rich concentrations (15 to 28 per cent. according to volume).

These hazards are obviously inherent in the nature of cold storage premises. And just as clearly, they must be obviated. It cannot be too often repeated, then, that here, even more urgently than in other industries, fires simply must not be allowed to develop. The initial outlay on fire extinguishers and other safety measures can therefore be considered the minimum insurance expense possible.

Plastics Federation's Abstracts.—Members of the British Plastics Federation were reminded by the chairman at their recent conference at Torquay of one of the most valuable activities of the Federation—its service of abstracts from journals, covering practically the whole world, and patents, of interest to all concerned in the manufacture or use of plastics. These deal with materials, processing methods, machinery and applications. The most important journals from which the abstracts are taken are available in the Federation library, 47–48 Piccadilly, London, W.1., to all subscribers and copies of articles can be supplied intact in the original journal, or in photostat or microfilm form.

Why pay more Tax than necessary?

[*A nice thought for the festive season.*—ED.]

By LORD MESTON

OF course, everyone who is entitled to do so puts in a claim for income tax relief on what they have spent on repairs, redecorating and fire insurance. Is that so really? Surely not *everyone*.

The bare fact is that 5 per cent. of the persons concerned put in a claim for relief while 95 per cent. of people who pay "schedule A" income tax never claim any relief.

It is only fair to say that an appreciable portion of that 95 per cent. may not have spent a sufficient sum of money on repairs etc. to entitle them to make a claim for relief, but there still remains a very large body of taxpayers who do not appear to be aware of the fact that they are paying more income tax than they need under this heading.

"Income" is grouped under five schedules: A, B, C, D and E. This division does not correspond precisely with the sources from which the income is derived. Thus, schedule A relates to property in land, but some of the profits derived from such property are charged under schedule D. However, it is not necessary here to discuss these fine points of taxation law, but rather let us concentrate upon the first-named schedule.

Income tax under schedule A "is charged in respect of the property on all lands tenements, hereditaments and heritages in the United Kingdom capable of actual occupation, for every 20 shillings of the annual value thereof." The word "property" is not to be read in any technical sense so as to restrict the persons chargeable to the owners of the lands, etc.; these include any person who has a right of occupation or of ownership which gives that person the enjoyment of the whole or part of the annual value.

Under schedule A the tax is in general paid in the first instance by the occupier of land, but if he is a tenant he can deduct tax against his landlord on the payment of rent. An owner of land, if he is also the occupier, pays tax directly; but whether he has paid it himself or borne it by deduction, he is entitled to deduct tax against a mortgagee or other chargee.

The year of assessment for the purpose of income tax begins on April 6 and ends on the following April 5. Under schedule A the annual value of the land as fixed for that year constitutes the taxable income of the year of assessment.

Where a trade is carried on upon any premises in respect of which income tax is payable under schedule A, a further assessment is made under schedule D in respect of the profits of such trade. In computing those profits, allowance is made for the annual value of the premises.

The next important matter to consider is the ascertainment of "annual value." The annual value of premises for the purposes of schedule A are :—

"(*a*) If they are let at a rack rent and the amount of that rent has been fixed by agreement commencing within the period of seven years preceding the fifth day of April next before the time of making the assessment, the amount of the rent by the year at which they are let; or

"(*b*) If they are not let at a rack rent so fixed, then the rack rent at which they are worth to be let by the year."

The annual value which is to be calculated as above stated is the "gross annual value." The full assessment (*i.e.* the "gross annual value") on the annual value of lands or buildings is reduced for purposes of collection by an amount commonly called the "statutory repairs allowance" which is intended to cover all expenses incurred in connexion with the upkeep of the property (including insurance premiums). The reduced amount is known as the "net annual value."

In the case of a house or building where the owner is occupier or is chargeable as landlord, or where a tenant is occupier, and the landlord has undertaken to bear the cost of repairs, the reduction,

(*a*) Where the assessment does not exceed £40, is a fourth;

(*b*) Where the assessment exceeds £40 but does not exceed £100, is a fifth;

(*c*) Where the assessment exceeds £100, is a sixth plus £20.

Relief may be given in respect of maintenance, repairs, insurance and management. The relief is given to the "owner," where the cost to him of maintenance, repairs, insurance and management has, on an average of five years, exceeded the reduction above authorized in the case of houses or buildings.

The average is computed on the five years preceding the year of assessment; years ending on March 31 are taken unless the owner and the inspector of taxes agree to another date. But the inland revenue are very reasonable and indeed most helpful in this matter. Therefore, if the taxpayer has owned the house for a shorter period than five years the inspector of taxes will usually

allow him to claim on a year-to-year basis until five years have gone by and an average can be built up.

It has been held that the term " maintenance " may cover the cost of employing a surveyor. The term " management " does not include payments of compensation for disturbance or expenses of litigation. It does include advertising expenses. The term " insurance " does not include a leasehold redemption policy.

The claim must be made within six years after the assessment to which it relates.

If the taxpayer has spent appreciable sums on repairs, insurance, etc., on his property during the past six years and has not put in a claim for relief in respect of that period, or any part of it, he should certainly do so now. He should collect all receipts, bills, invoices, and other material documents relating to moneys spent during the past six years on such matters and put these documents in order in respect of each year, *e.g.* put each year's receipts, etc., in a separate file or envelope, and send the entire collection to a qualified accountant who will advise the taxpayer as to whether he is entitled to make a claim for relief under schedule A ; and if there is a likelihood of such a claim succeeding the accountant can put the matter in order for submission to the inspector of taxes.

Let us end up on a practical note. Take a house with a " gross annual value " of £60. The " statutory repairs allowance " is one-fifth of that figure, and is therefore £12. In the past five years, the owner's expenditure has been as follows :—

Year ended March 31	*Expenditure*
1953	£31
1954	£70
1955	£45
1956	£26
1957	£48
	£220

Average expenditure is therefore $\frac{220}{5}$ = £44.

The statutory repairs allowance is = £12.

Subtract the figure of £12 from £44, and therefore the average amount spent on repairs each year has exceeded the statutory repairs allowance by £32.

The owner may thus claim tax paid on £32.

At 8s. 6d. in the £, this equals £13 12s.

The above simple example should make it clear to the taxpayers that it may often be well worth their while to make claims for relief under schedule A.

New Holding Plant for Forte's

JUST three months ago Forte's moved their central warehouse and distributive organization from the Mount Pleasant premises to 27–34, Walnut Tree Walk, Lambeth. From here, food is despatched to 100 outlets, which include the Festival Gardens, The Waldorf, The Talk of the Town, The Café Royal and London Airport.

Nearly 3,000 gal. of ice cream, 5 tons of sausages, 4 tons of hamburgers, 15 tons of meat, 2½ tons of bacon, 1½ tons of canned meats and 6,000 head of poultry pass through this new warehouse in a peak week. One of the essentials to its smooth running and success is the refrigeration provided by Frigidaire and supplied and installed by R. E. A. Bott (Wigmore St.) Ltd.

A total of 10,860 c.ft. of refrigeration has been installed : a large despatch cold room, a sectional cold room in five compartments and a further sectional cold room divided into two rooms.

The despatch cold room is a 1,360-c.ft. store for meat used in the preparation of sausages, and it operates at 36° to 40° F.

The first of the five cold rooms in the large sectional cold room is a 1,050-c.ft. poultry cold room operating at 32° to 34° F. Then there is the meat chiller/freezer room of 1,850 c.ft. capacity which is designed to operate at two temperature ranges. A manual thermostat operates the change-over in temperature from 28° to 32° F. to 14° to 16° F. or vice versa.

In addition there is a meat freezer of 1,650 c.ft. which operates at 14° to 16° F. The remaining rooms are the sausage meat cold room where the prepared meat is stored, and the bacon cold room. The former is of 920 c.ft. capacity operating at 28° to 32° F., and the latter of 930 c.ft. operating at 36° to 40° F.

The two-compartment sectional cold room contains a 1,800-c.ft. ice cream cold room and the 1,300-c.ft. milk and general produce cold room. The temperature of this last cold room is maintained at 40° to 45° F.

The new premises used to be an engineering shop and prior to that a garage. Appropriately enough Forte's keep half their distributive transport at this immense depot.

" Frostmaster " automatic electric defrosting equipment is fitted to the five-sectional cold room and to the ice cream cold room.

Air-Conditioning of Railway Rolling-Stock

By J. C. WARE*

THE question of passenger comfort in railway trains is assuming increasing importance as competition from other forms of transport is intensified.

The most common complaints lodged by passengers are of dirt, stuffiness and incorrect temperature in the carriage ; these complaints can be largely met by the installation of complete air-conditioning. This implies the provision of heating, cooling, air cleaning and correct air distribution to give a resultant sense of comfort without draught or temperature gradient between floor and roof of the coach.

In many quarters there is a tendency to exaggerate the cost of air-conditioning. It is hoped that the following article will present the economic considerations in their proper perspective as well as to touch on some of the problems involved with air-conditioning and the methods of overcoming them.

Usually the emphasis is either on cooling or heating, depending on the location of the railway, either in tropical or temperate climates. In either case, the less important comfort feature can with advantage be included in the basic equipment without much additional cost.

As an example, for railways operating in North America and Europe, the emphasis is on winter heating. Reasonable passenger comfort during winter entails very considerable power for heating, either in the form of steam, or with the modern trend of diesel or electrical hauled trains, electric power.

During summer months, especially in countries with a " Continental climate " such as North America and Europe, high temperatures are also met and cooling equipment can be added to the heating equipment already available, for a modest sum, as the power required to drive the cooling equipment is already available to provide heating during winter. It follows, therefore, that when considering the provision of full air-conditioning in a railway coach, it should not be dismissed as being entirely uneconomic on account of the high first cost, as in most cases, power which is often the most expensive feature of the equipment is already available to operate the heating or cooling that is already considered essential and the missing comfort feature can be provided at only a small cost.

Naturally, the cost of full air-conditioning will vary from one application to another, as where large cars are operated with considerable passenger loading, in the neighbourhood of 70 to 100 passengers per coach, the requirements of air-conditioning, whether it be heating or cooling, are very much greater than those for a similar size of car operating on the same railway used for luxury purposes, where perhaps the passenger loading is only 30 or 40 passengers.

The heat leakage through the coach structure, from a hot ambient to a cool car, forms only a small percentage of the load on the equipment, especially if the coach is insulated and fitted with double windows. The bulk of the load is dictated by the ventilation requirements, which depend on the passenger loading, and in the case of cooling equipment, on the heat given off by the passengers.

The following table may be of interest to show the proportions of the total heat gained from various sources under conditions of maximum *cooling* in a *typical* insulated sealed and force ventilated coach operating in the tropics :—

Source of heat	*Approximate percentage of total heat load*
Cooling and dehumidifying of outside air	45
Conduction through car body ...	12
Given off by passengers and electrical apparatus within the car	23
Radiation from sun (this factor is at the maximum when the coach is stationary and the body and roof surface temperatures are above the ambient shade temperature) ...	20

It will be seen, therefore, that within limits for a given surcharge per passenger, to offset the

* J. Stone & Company (Deptford) Ltd., London, S.E.14.

capital cost and maintenance charges of the air-conditioning equipment, it is immaterial whether one is air-conditioning a coach with a large passenger load or a coach with a small passenger load, since the equipment capacity as indicated above is largely established by the number of passengers carried.

There are further benefits derived by the railway in addition to the benefits given to the passengers in travel comfort from coaches fitted with air-conditioning. Wear and tear on upholstery and internal decoration are reduced, as with fixed windows the air in circulation is relatively clean. Also, fixed windows have fewer maintenance problems than movable ones.

The introduction of high-speed train services brings problems of ventilation, dirt and noise as, if windows are opened, conditions will quickly become intolerable, and full air-conditioning is the only answer.

Let us now examine the requirements of a satisfactory railway air-conditioning equipment and the methods that are available to meet these requirements :—

Requirements for Passenger Comfort

(*a*) Uniform temperature within the accepted comfort zone without draught or temperature gradient between floor and ceiling, irrespective of outside conditions.

(*b*) Clean atmosphere and upholstery.

(*c*) Adequate ventilation with outside air.

Railway Requirements

(*a*) Low first cost.

(*b*) Simplicity.

(*c*) Reliability with the minimum of maintenance.

(*d*) Efficient utilization of power.

(*e*) Minimum weight.

The purpose of this article is mainly to discuss alternative methods of producing the cooling effects required in full air-conditioning, as the alternative methods of heating are more widely known.

SUMMARY AND ANALYSIS OF POSSIBLE COOLING SYSTEMS

The following systems for application in railway air-conditioning have been considered :—

(i) Absorption cycle.
(ii) Steam ejector.
(iii) Air cycle.
(iv) Water ice.
(v) Evaporative system.
(vi) Mechanical refrigeration.

(i) *Absorption System.* This system is heat operated and employs a refrigerant and an absorber.

The air to be conditioned is passed over a heat exchanger (evaporator) through which a refrigerant is passed. The air is cooled and the refrigerant vapour is passed to a container (absorber) where it becomes dissolved in a second fluid known as an absorbent. A pump passes the strong liquor through a heat inter-changer to a generator where heat is applied, causing the refrigerant to evaporate together with a certain amount of the absorbent. The warmed liquor in the generator is thus weakened and is returned, also via the heat interchanger, to the absorber tank.

The vaporized mixture from the generator is passed to a rectifier where selective condensation of the absorbent takes place, this being returned to the generator. The remaining purified refrigerant vapour is condensed in a further container (condenser) and is then returned to the evaporator via an expansion valve.

Water is passed through a coil in the absorber where it is cooled, and is then passed through the condenser and the rectifier in turn and finally rejected. In very small capacity units the cooling of the condenser and rectifier can be done by means of forced air draught but above fractional tonnage units full water cooling would be necessary. (Evaporative condensers are normally used to save water.)

The absorption system has at first sight certain attractions ; it is flexible and easy to adjust to the actual operating requirements ; it is silent and free from vibration also as the power required is in the form of heat it can be supplied from the train steam-line or electrically, whichever is the most convenient.

On the other hand its efficiency is low ; a considerable water supply is necessary which is quite a problem in railway services ; dimensionally the equipment is bulky and either a full steam supply must be available all the year or a considerable electrical power supply.

This system has not been developed for railway coach air-conditioning although one or two limited applications have been made for freight car refrigeration duty. A great deal of experiment and development would have to be undertaken before the possibility of such a system could be fully assessed.

The power requirements, supplied in the form of heat, are a most important consideration in the case of railway air-conditioning, and in this case are approximately double those of the more orthodox mechanical or electro-mechanical systems.

(ii) *Steam Ejector.* This system uses water as the refrigerant. The water is cooled in a flash tank

where the pressure is reduced by a steam jet ejector. The water level in the flash tank is maintained by a spray and float valve. The main steam ejector creates a vacuum of approximately 29½ in., at which pressure water boils at a temperature of 50° F. If the supply of water in the tank is above this temperature some of it will boil, the latent heat of vaporization coming from the remaining water in the tank which may then be drawn off by a pump and used in a heat exchanger to cool and dehumidify the coach air. The water now at higher temperature is returned to the flash tank.

The water vapour, together with any entrained air boiled off from the water, and the steam from the ejector are passed through an evaporative condenser to recover the water, which is partly used to replenish the level in the flash tank and partly as make-up water for the evaporative cooling of the condenser. A centrifugal pump and a secondary ejector is used to remove the air from the condensate and spray it over the condenser together with a further supply of air from a fan. A further make-up water tank is required to compensate for the water used in the evaporative condenser, as the water from the steam ejector is usually insufficient for this.

The steam ejector is simple from the point of view of the number of moving parts and thus the maintenance costs should be fairly low ; steam as a source of power can be obtained from the train steam line ; it should be reasonably silent and vibrationless, and the electrical power requirements are low.

It has, however, the inherent defect of low efficiency and requires a fairly large supply of treated water ; it is bulky and heavy and full steam must be supplied all the year round.

The system has been fully developed in the United States but is now largely superseded by other more orthodox systems. It is not to be recommended for modern use as steam is progressively disappearing from railway service. Moreover, the equipment is really only suitable for use in desert climates where full advantage can be taken of evaporative cooling for the condensers.

(iii) *Open-air Cycle System.* In this system the actual coach air is used as the cooling medium, work being done on it to raise its temperature and pressure in a compressor. As the air is then at a temperature greater than that of the ambient it can be cooled by passing ambient air over an inter-cooler. The air leaving the inter-cooler is expanded throughout a turbine mechanically coupled to the compressor where work is taken from the air. It finally passes into the coach through a water separator at normal pressure but greatly reduced temperature.

By controlling the amount of outside air passed over the inter-cooler the amount of cooling of the coach air can be controlled and heating for winter conditions can be produced.

This system has been tried on one railway experimentally and is in common use on aircraft. It suffices to say that owing to the low specific heat of air the power required which is at a premium on railway coaches, is of the order of 40 h.p. per coach, two or three times that associated with direct mechanical or electro-mechanical refrigeration.

It is understood that the experiments on the railway have been abandoned and that the car concerned was never put into passenger-carrying service. Its further development does not seem justified for railway passenger vehicles.

(iv) *Water Ice System.* In this system, water, cooled by spraying it over ice blocks stored in watertight tank, is pumped through a heat exchanger where the coach air is cooled and dehumidified. Excess water due to the melting ice is rejected at the highest temperature possible by passing it through a supplementary heat exchanger in the outside air intake.

Control is achieved by varying the water pump delivery.

Full flexibility of the control can be obtained with the water-ice system which is the simplest of all systems, resulting in cheapness and low maintenance costs. It is silent and vibrationless and power consumption is small.

The cheapness of the coach installation is, however, counter-balanced by the necessity for refrigerated ice storage space and the actual ice used results in high running costs compared to other systems. The provision of labour for loading ice on to the coaches is often inconvenient and costly, moreover, operation of the coaches is limited to such section of the railway system where icing facilities are available.

The ice-cooled system will, without doubt, produce satisfactory air-conditioning and where the cooling season is short and the cost of ice low, it may be economically justified. Having regard, however, to the fact that cooling might be required for long periods, and at irregular times, the problems involved in icing the car, the installation of ice bunkers on a large number of stations and the possible need for manufacture and storage of ice by the railways themselves make for a complicated operating organization compared with the simple electro-mechanical system of air-conditioning which is entirely self-contained.

(v) *Evaporative Cooling.* In this system the air to be cooled is passed through a chamber where water is sprayed through it from atomizers. Some of the water is evaporated causing a drop in

temperature at the cost of a rise in the relative humidity of the air. Baffles are placed at the outlet of the chamber to remove the free water from the air. The excess water is drained to a sump where a pump feeds it to sprays. A make-up tank maintains the level in the sump.

This system, therefore, depends on the ambient conditions having a lower humidity than that required inside the coach, otherwise cooling can only be achieved by creating uncomfortable humidity conditions inside.

As the cooling effect of an evaporative system is dependent on a low humidity in the outside air it follows that it can only be used under desert conditions and then only for part of the day.

(vi) *Mechanical Compression System.* The majority of the railways throughout the world have standardized on mechanical refrigerated equipments as they are the most efficient, simple and adaptable.

A straightforward piston-type compressor is used to circulate refrigerant CF_2CL_2 with a closed circuit.

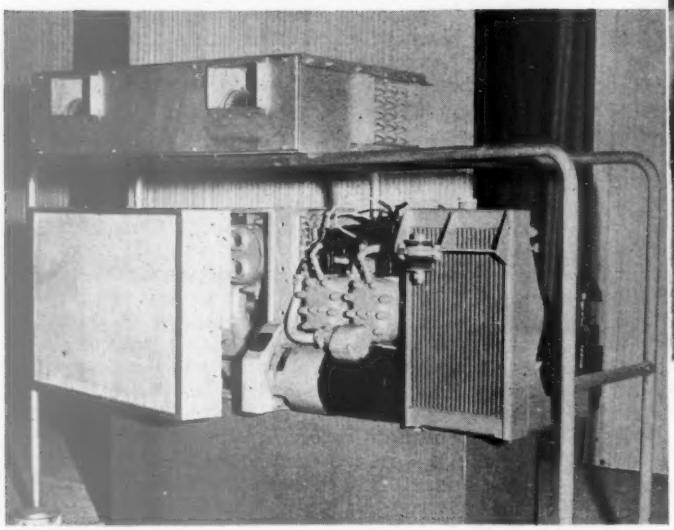
The power required for the system is normally obtained either from an axle-driven generator and associated storage batteries, or from an internal combustion engine either mechanically coupled to the compressor, or driving through a suitable generator and motors.

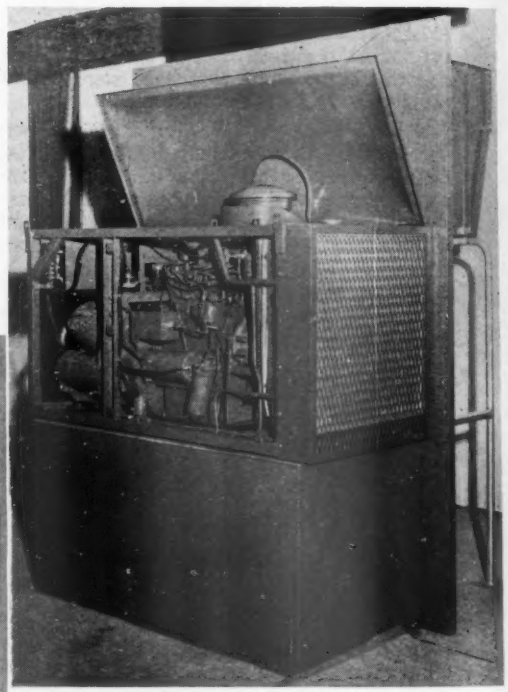
The conclusion reached by both operators and manufacturers based on over 25 years' experience is that, for the cooling cycle of a railway air-conditioning equipment, mechanical refrigeration shows to the best advantage, primarily on the basis of low operating costs, low weight and economical utilization of power.

Stone-Carrier Air-Conditioning Units

It was our pleasure recently to inspect a comprehensive display of equipment, mainly concerned with the comfort of the travelling public, here and abroad, which is being produced by J. Stone & Company (Deptford) Ltd. This plant included several items made under licence from Messrs. Carrier, Stone-Carrier bus cooling plant and some "just off the factory floor" pieces for British Railways. B.R. will soon be putting into commission fully-air-conditioned trains between London—Bristol and London —Midlands. This equipment will be described next month.

Carrier refrigeration compressors are being made by Stone's in south-east London.





Stone-Carrier Bus Air - Conditioning Equipment.

Stone-Carrier Truck Trailer Cooling Plant.

International Ice Plant Makers Confer

EACH year a conference of manufacturers of the Wilbushewich Rapid Ice Plant is held in one of the countries of the licencees of this system.

This year's meeting was held in the autumn at the works of the British licensees, Messrs. J. & E. Hall Ltd., of Dartford, Kent. The following firms were represented as licencees :—

J. & E. Hall Ltd., England.
A/S Drammens Jern, Norway.
Construzioni Meccaniche Barbieri s.r.l., Italy.
Gebr. Plersch, Germany.
Société des Usines Quiri & Cie, France.
Ramon Vizcaino S.A., Spain.
Rapid-Ice-Freezing Ltd., Switzerland.
Rapid-Ice-Freezing Italiana, s.r.l.

The agreement to meet annually showed its value during this third convention. At the time of the first convention, at Bologna, 1956, a total of 60 installed Rapid-Ice plants were reported and, at the second annual convention held at San Sebastian, in 1957, the number of completed Rapid-Ice installations had increased to 100.

The different methods of circulating ammonia were described, and the standardization of Rapid-Ice plants came up for detailed discussion. Many technical experiences, and some of a commercial nature, were exchanged. The operation of the plant was demonstrated at Messrs. Hall's.

It was noted that there are at present in operation in various parts of the world 125 Rapid-Ice plants, some having a capacity of 100 tons. Messrs. J. & E. Hall Ltd. have also started to export.

There are a number of orders in hand, from U.S.A., Central and South America and, in particular, for fisheries, from Scandinavia. Certain constructional improvements in the Rapid-Ice plants have been introduced during the year.

OBITUARY

Mr. George Tait

WE regret to have to record that Mr. George Tait, the well-known refrigeration engineer of The Midland Counties Dairy Ltd., Birmingham, died suddenly on October 20, after a brief illness, at the age of 65. Although of Scottish descent, Mr. Tait was born in Tralee and served his engineering apprenticeship in Ireland, continuing his professional training on the Clyde. He spent some years in the Merchant Navy and during the first world war he was commissioned in the R.N.V.R., seeing action with Atlantic convoys.

Mr. Tait joined The Union Cold Storage Ltd. in 1919 as engineer-in-charge of the Entrepôt Frigorific de L'Union of Le Havre. During the following years Mr. Tait had considerable experience with cold storage installations and in 1927 he became an associate member of the Institute of Mechanical Engineers.

With the overrunning of France in 1940, Mr. Tait and his family were forced to return to England and for a short time he worked for Eldorado Ltd. Later, he was seconded to the Ministry of Food for construction and supervision of emergency cold stores in the North of England.

After a short return visit to France in 1945, Mr. Tait joined Midland Counties Dairy as chief refrigeration engineer where he was responsible for the main refrigeration installation at Corporation Street (considered to be the largest in the midlands) as well as storage depots throughout the midlands and north.

The Determination of the Cooling Loads of Refrigerated Trailers

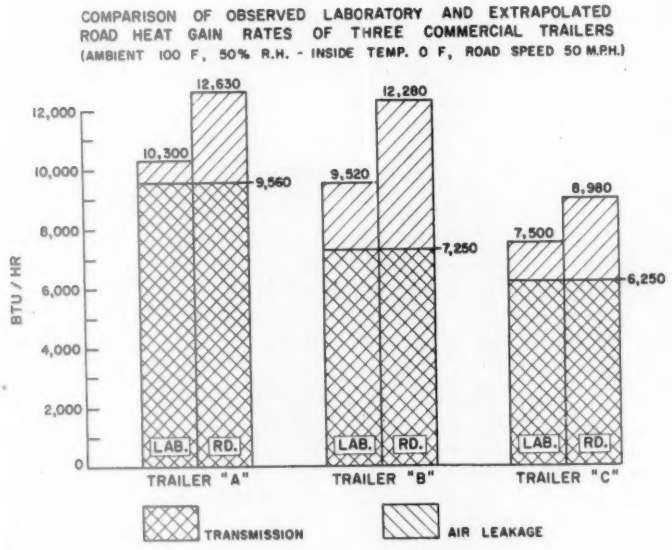
THE U.S. National Bureau of Standards is currently studying a suitable method for determining the cooling loads of refrigerated trailers in a programme sponsored by the U.S. Department of Agriculture, the U.S. Quartermaster Research and Engineering Command, the American Truck-Trailer Manufacturers' Association, and the U.S. National Bureau of Standards itself.

The objective of this co-operative project is the development of a standard laboratory rating method that will *adequately simulate the heat transfer conditions under which trailers are actually operated on the road.*

Work on the project is now well under way. Cooling loads of typical trailers have been compared in the laboratory and on the road, methods are being devised to simulate the effects of solar radiation and wind pressure, and air and moisture transfer processes through trailer walls are being investigated. Results so far indicate that any laboratory method must include a means for simulating the air leakage that occurs on the road ; significant reductions in cooling load would be realized if air leakage could be eliminated.

At present there is no standard method in common use to determine accurately the cooling load of a refrigerated trailer. An accurate method would enable the trailer manufacturers to establish a rating for each of his models ; and the purchaser, knowing this rating, the product load contributed by the commodity being carried, the length of haul, and certain environmental conditions, could then select the most economical and efficient refrigerating equipment for his needs. The method under development by P. R. Achenbach and C. W. Phillips of the bureau's refrigeration laboratory promises to provide the manufacturer with a reliable technique for determining these ratings.

Three 35-ft. refrigerated semi-trailers were chosen for the laboratory and road tests. The laboratory consisted of an insulated structure specially equipped with humidity and temperature control facilities. The trailers were placed inside this building, on three calibrated platform scales to determine the weight gain caused by condensation of infiltrated moisture. An adjoining room was equipped with suitable controls and instruments. Outside the test structure was installed a prototype comparison heat-sink apparatus. This consisted



This bar graph shows comparative laboratory and extrapolated road heat gains for three trailers. It indicates the computed values of heat transfer caused by air leakage and transmission in each case.

The U.S. National Bureau of Standards has been developing a method for determining the cooling loads of refrigerated trailers. Picture shows the test site at the bureau, and the specially equipped tractor for the road tests.

of sectionalized, semi-portable, refrigerating equipment which included three motor-driven, two-speed compressors with water-cooled condensers, two brine chillers, and a metered heat comparator.

A refrigeration coil with an integral blower was placed inside the trailer at approximately the same height above the floor as in typical trailer-refrigerating units. When needed, an electric space heater was used to counteract the excess cooling capacity of the refrigerating units.

Thermocouples were installed inside and outside the trailer near the walls to measure the average interior and ambient temperatures. Several large fans circulated the air around the trailer to promote uniform ambient temperature and humidity within the test structure. Controls and equipment were set and adjusted to maintain the selected standard test conditions — 0° F. inside the trailer and 100° F. and 50 per cent. relative humidity outside the trailer.

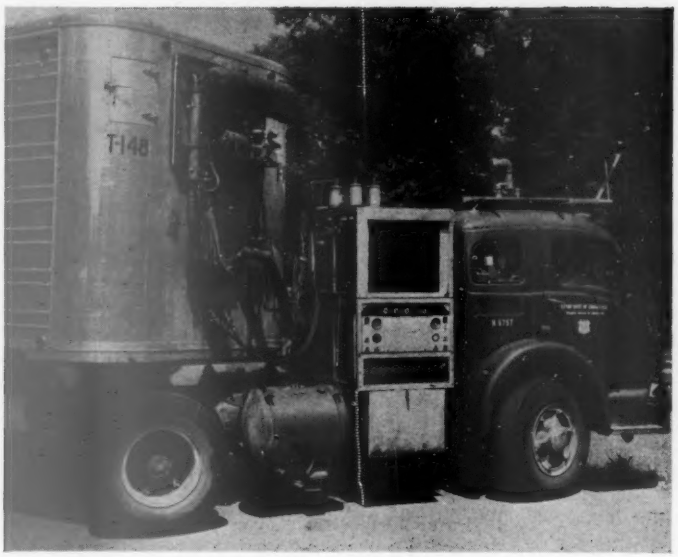
The laboratory tests of each trailer were made to determine the cooling load and simultaneous gain in weight due to the accumulation of water or ice under the standard test conditions. Chilled brine was circulated at a constant rate through the cooling coil inside the trailer and around an electric heater immersed in the brine circuit outside the trailer. The temperature rises produced in the brine by the heat absorbed inside the trailer and by the electric heater were measured as well as the power used by the electric heater. By equating the ratios of the two temperature rises and the two heat energy sources, the unknown cooling load of the trailer could be determined.

For the road tests, carried out at 50 m.p.h. average road speed, a tractor was altered to carry a two-stage, petrol-engine-driven refrigerating system and an electric generator, also petrol-engine-driven. Controls and instrumentation for measuring the cooling load of the trailers were mounted inside the cab. The cooling load was determined by observing the rate of chilled brine circulation through the cooling coil, the temperature rise of the brine inside the trailer, and the electric energy dissipated inside the trailer by fans and other equipment.

Comparison of laboratory and road tests shows that the heat gain of a refrigerated trailer was significantly greater during road operation than under stationary laboratory conditions for the same ambient temperature and humidity. This increase ranged from about 20 to 30 per cent. for the three trailers at ambient conditions of 100° F. dry-bulb temperature and 50 per cent. relative humidity (R.H.). Since these ambient conditions were not attained during the road tests, this comparison is based on extrapolation of the observed data to the standard laboratory test conditions. The extrapolated heat gain values of the three trailers for these conditions ranged from 9,000 to 12,600 B.t.u. per hour for a road speed of 50 m.p.h.

The increase in heat gain on the road was due principally to air leakage into the trailer construction under the impact pressure of the air against the front of the trailer. Additional small increases were caused by solar radiation and the movement of air, heated by the engine, under the floor of the trailer.

The air leakage and ice accumulation in the trailers were not negligible even under stationary conditions in the laboratory. The weight gain rates caused by ice accumulation averaged 0·32, 0·54 and 0·98 lb. per hour for the three trailers



Close-up view of the tractor, showing the refrigerating equipment, some of the brine circulating equipment on the front of the trailer, and humidity, temperature and solar radiation instruments on the roof of the tractor.

during the laboratory tests. By assuming that the leakage air entered the trailer walls at ambient conditions of temperature and humidity and left the trailer body saturated at 0° F. the air leakage rate and the heat transferred to the cooling unit by the air leakage were computed for each trailer from the rate of weight gain. On this basis the minimum air leakage rates in the laboratory were 235, 395 and 715 c.ft. per hour and the corresponding values of heat transfer caused by the air leakage were 740, 1,250 and 2,270 B.t.u. per hour.

If the heat transmission rate per degree temperature difference on the road, exclusive of heat transferred by air leakage, were assumed to be the same as in the laboratory, the air leakage could be deduced for the road tests. This procedure results in minimum air leakage rates for the road tests of 970, 860 and 1,590 c.ft. per hour and corresponding heat transfer rates of 3,070, 2,730 and 5,030 B.t.u. per hour caused by air leakage at the standard test conditions. On this basis, the heat gain due to air leakage ranged from 32 to 69 per cent. of the transmission heat gain. These percentages indicate that significant reductions in cooling load could be achieved by eliminating air leakage in trailer bodies.

The effects of solar radiation on a trailer are largely nullified by the rapid air motion over the vehicle at 50 m.p.h. In a typical test at this road speed in bright sunshine, incident solar radiation raised the surface temperature of the roof and one side of the trailer about 7·5° F. above ambient air temperature. On a weighted-average basis this corresponds to approximately three degrees rise in temperature for the entire exterior surface. When the trailer was sitting still, the sun sometimes raised the roof temperature by as much as 25°.

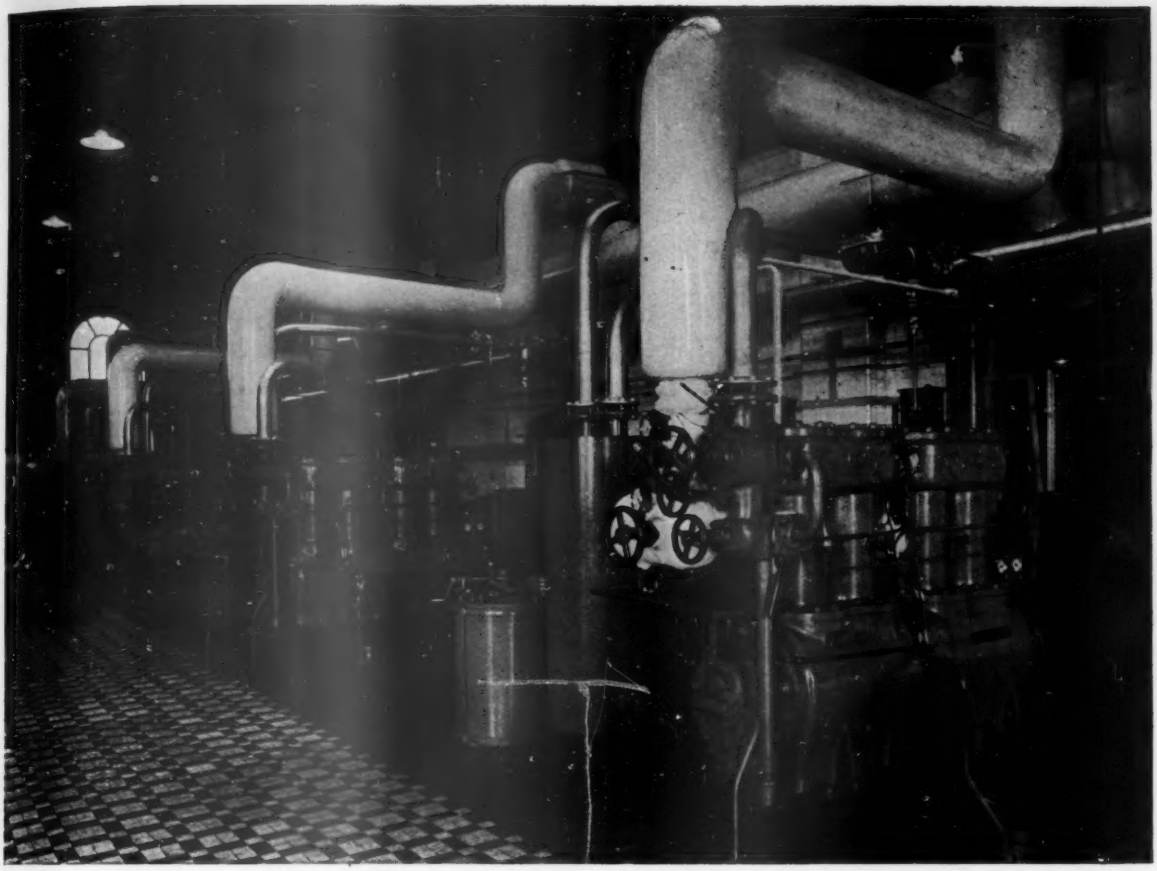
The underside of the trailer warmed up as much as 15° above ambient temperature during road operation, principally by waste heat from the tractor engine. This rise would not cause a very large increase in overall heat gain of the trailer unless chilled air were circulated around and under the load.

At 50 m.p.h., impact air pressures up to 1·25 in. water gauge (w.g.) occurred on the nose of a trailer where it was not shielded by the tractor, although the average pressure over the entire front end of the trailer was probably considerably below this value. The static pressures in the cargo space, in the insulation space, and over most of the exterior skin surface (excluding the nose) were about equal and ranged from 0·2 to 0·4 in. w.g. below the pressure of the undisturbed atmosphere as measured ahead of the vehicle. The leakage air probably entered the trailer body primarily on the nose of the trailer and left the body over the remainder of the surface. Most of the moisture in the ambient air was deposited as ice in the insulation space. The air exchange between the insulation space and the outdoors was probably several times greater than between the cargo space and outdoors.

The results suggest that smaller refrigerating units could be used if air leakage could be eliminated ; alternatively, less insulation would be required if air leakage were significantly reduced. Moreover, if moisture could be kept out of the insulation spaces, deterioration of trailer bodies would proceed more slowly.

REFERENCE

" Cooling Loads of Refrigerated Trailers under Laboratory and Road Conditions." Bulletin AMS 250, Agricultural Marketing Service, U.S. Department of Agriculture.



Refrigeration

Refrigerating compressors of the monobloc type are widely used in the manufacture and storage of foodstuffs. This installation comprises four 8″ x 8″ quad and an 8″ x 8″ twin monobloc compressor, driven by a total of 675 h.p., and have an installed capacity of 6½ million B.t.u. per hour. It is installed at the margarine plant of the Co-operative Wholesale Society at Irlam, Manchester. The equipment manufactured by J. & E. Hall ranges from small refrigerated cabinets and compressors of ¼ h.p. to centrifugal compressors of the largest size in use today.

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AP 203

Refrigeration Controls—12

SPECIAL FEATURES OF CERTAIN THERMOSTATIC EXPANSION VALVES

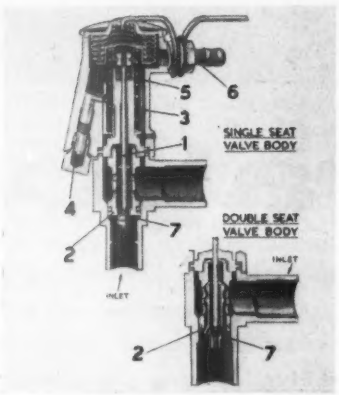
By H. H. EGGINTON

(*Continued from November issue*)

(*Conclusion of Series*)

Externally Equalized Valve (*see fig. 41*)

IN the normal thermostatic expansion valve of the internally equalized type, the underside of the bellows and the outlet are at the same pressure, being connected by the clearance around the push rod or a port. The evaporator pressure on the underside of the bellows is therefore the same as that at the evaporator inlet. If there is a large pressure drop across the evaporator the saturation temperature of the liquid near the evaporator outlet is much lower, but the phial must still be heated to a temperature which is high enough to allow the pressure in the thermal system to overcome the pressure of the evaporator at its inlet plus the superheat spring pressure. Now, in order to warm the phial to this temperature the vapour passing under it may have to be superheated to, say, 20° F. above the temperature of the liquid at the evaporator outlet and this means that the valve is not being used to its best advantage.



By courtesy Teddington Refrigeration Controls Ltd.

Fig. 41.—Externally equalized valve.

1. Valve spindle
2. Valve seat
3. Range spring
4. Superheat adjustment
5. Gland packing
6. Equalizer connexion
7. Valve head.

In order to correct this the parts of the valve through which the pressure of the evaporator is connected to the underside of the bellows are isolated, by, say, glanding the push rod, and the space around the bellows is connected by a pipe to the suction line. Thus, the pressure acting upwards on the underside of the bellows, the true evaporator outlet pressure, is the condition for which the superheat is controlled.

Since most packed glands leak a little it is recommended that the equalizer connexion be made to the suction line after the point at which the phial is fitted. This ensures that whatever is passing through the equalizer pipe has no effect on the phial temperature.

It is recommended by the A.S.R.E. that an externally equalized valve be fitted when the pressure drop across the evaporator exceeds a pressure corresponding to 2° F. of open superheat.

Self-contained Valve (*see fig. 42*)

In this type of valve the thermal system consists only of a bellows located in the suction line. This has the following advantages :—

(1) A gas-charged valve can be used and the question of reversal does not arise because there is no other space for the charge to distil.

(2) The thin-walled bellows in intimate contact with the suction vapour ensure a very close control over superheat and are unlikely to be affected by extraneous factors.

(3) If a small gland bellows is used to carry the motion of the main thermal bellows to the push rod, the valve controls on evaporator outlet pressure and is unaffected by pressure drops in the evaporator.

The general advantages of this valve, coupled with the use of a thermal bellows of large area, make it especially useful for large-cabinet low-temperature work.

Pressure Limiting by Mechanical Means

Expansion valves are made with adjustable limiting pressure characteristics, so that the valve can be matched to given evaporator pressures, shut off requirements and prevent motor overload under pull-down conditions. Each valve is therefore job set to particular requirements of the plant. Such valves usually have twin prime movers, one thermal and one pressure, or a collapsing member, so that at the cut-off point the pressure element takes control completely, eliminating the thermal action which tries to open the valve. In fact, these valves usually act as constant pressure valves above the cut-off point, metering refrigerant to the compressor capacity, until the evaporator pressure falls below the set point, when thermostatic action is introduced. Such valves are commonly liquid charged, thereby giving freedom from reversal and motor protection by adjustment. The adjustable range of cut-off is usually 0 to 55 p.s.i. and the valves are normal in other respects of capillary, bulb, superheat adjustment and range, equalizer connexion, etc.

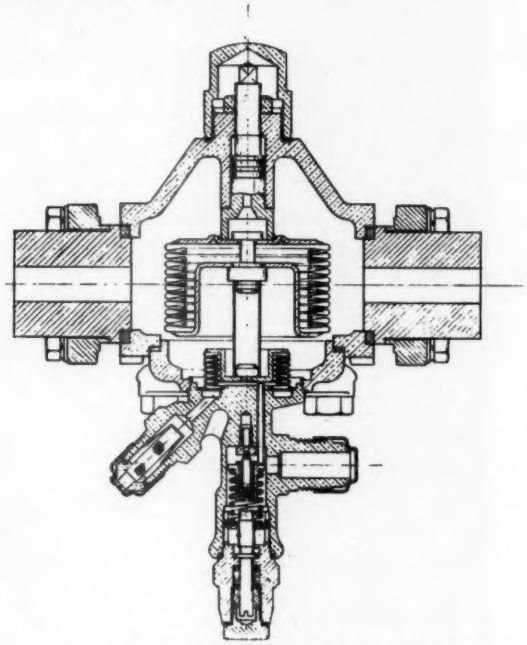
Distributors

The purpose of a distributor is to meter refrigerant in equal quantities to separate evaporator circuits. This enables one thermostatic expansion valve to be used to supply a number of circuits. The system is economical because only one expansion valve and one distributor are required. The pressure drop across the evaporator is reduced by using a number of parallel circuits, instead of one long circuit with a large pressure drop and better use is made of the plant.

Most distributors manufactured are of the pressure type and consist of a small orifice through which refrigerant and flash gas pass to impinge on a conical button and be deflected equally in all directions.

In order to force the refrigerant through the orifice a pressure difference must exist across it and this should be about 15 p.s.i. In addition to directing the refrigerant on to the cone the small orifice causes the refrigerant to reach a high velocity when going through the orifice and a turbulent mixing of liquid and flash gas takes place to ensure that the mixture reaching each circuit is of equal quality.

Distributors are made with venturi shape, and are credited with giving reliable distribution with a much lower pressure drop, although fitting to a valve with an equalizer connexion is to be recommended.



By courtesy Teddington Refrigeration Controls Ltd.

Fig. 42.—Self-contained valve, with suction feed through head of valve.

Three points to remember when fitting distributors are :—

(1) Since there is a pressure drop across the distributor it is necessary for a valve of the externally equalized type to be used.

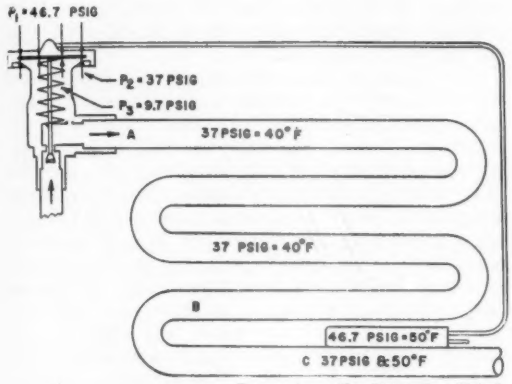
(2) The capacity of the valve will be decreased slightly because the pressure drop between high and low side within the valve, will not be so great due to the pressure drop across the distributor.

(3) All circuits must be equally loaded or the valve will fail to function correctly. This is the principal reason for trouble on circuits fitted with distributors and is particularly troublesome on air-conditioning where banks

of evaporators are used, the lowest loaded bank causing the valve to close early and so reduce the total amount of refrigeration. In some instances, the problems of balancing have been so great that a return has been made to multi-valve installations.

Application

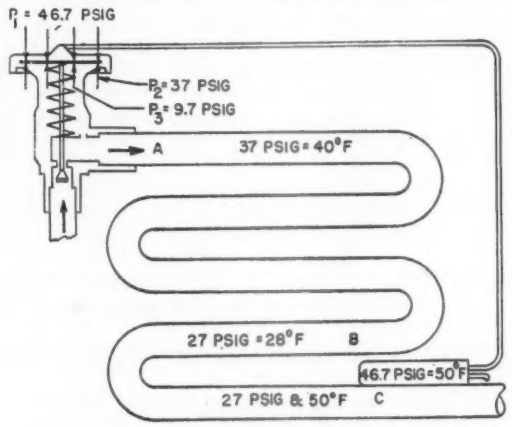
Earlier in this article the balance of forces on the prime mover was described, and it was pointed



By courtesy Alco Valve Co., U.S.A.

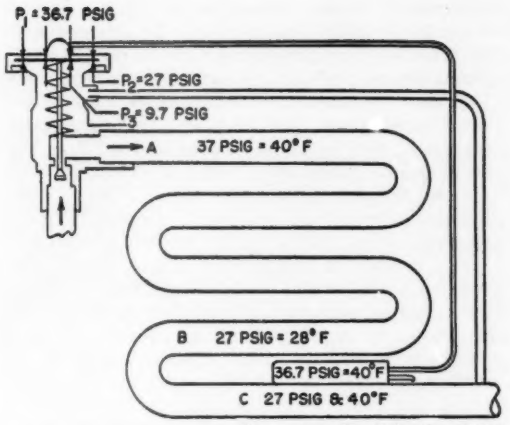
Fig. 43a.—Thermo expansion valve with internal equalizer on evaporator with no pressure drop.

out that with the phial 10° F, superheated above the evaporator pressure the valve is set to be about to open, and at 14° F. is open to rated capacity. Fig. 43a illustrates diagrammatically the state of affairs when the valve is just about to open with 10° F. superheat on Refrigerant-12. At point A



By courtesy Alco Valve Co., U.S.A.

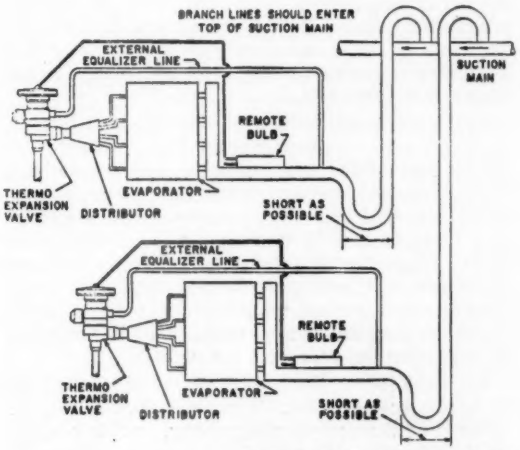
Fig. 43b.—Thermo expansion valve with internal equalizer on evaporator with 10 p.s.i. pressure drop.



By courtesy Alco Valve Co., U.S.A.

Fig. 43c.—Thermo expansion valve with external equalizer on evaporator with 10 p.s.i. pressure drop.

liquid refrigerant exists, the pressure of 37 p.s.i.g. giving the saturation temperature of 40° F. It will be seen that the pressure is operative all through the evaporator, and this is an ideal condition of an evaporator with no restriction, *i.e.* no pressure drop. At point B in the diagram, all the liquid has evaporated by absorbing heat equal to the



By courtesy Alco Valve Co., U.S.A.

Fig. 43d.—Schematic of recommended piping of rising suction lines to a common suction main.

latent heat of vaporization of the refrigerant, and thereafter the vapour is superheated. At point C the vapour is 10° F. superheated by the thermal load against the amount of refrigerant being metered by the valve, and the temperature no longer

corresponds to the saturation pressure. In this diagram the valve is assumed to be charged with the same refrigerant as the valve, and therefore gives a pressure equal to a saturation temperature of 50° F. This pressure is transmitted back to the prime mover and just balances the evaporator pressure P_2 and the superheat spring load P_3. The spring thrust is calculated from a load to a pressure based on the area of the prime mover. An increase of phial temperature to 54° F., *i.e.*, 4° F. more superheat, would give a power element pressure of 51 p.s.i.g. and the change of 4·3 p.s.i. would take the valve to the "open," to rated capacity refrigerant flow. The increased refrigerant flow would reduce the amount of superheat and as a result the valve would then throttle down, this leading to an increase in superheat, thereby opening the valve. Whilst the compressor is running the control is cycling in this manner. When the compressor stops the evaporator pressure rises and closes the valve.

The valve will remain closed even though the evaporator pipework and phial temperatures increase, unless the phial is subjected to a temperature more than 10° in excess of the evaporator pressure.

Fig. 43b illustrates the same conditions on an evaporator with a 10 p.s.i. pressure drop. Comparison with the previous diagram shows the main changes, the important point being the considerable increase in superheat, 22° F., to have the valve just about to open. As a result the point **B**, beyond which there is no liquid refrigerant, has moved back along the evaporator, and much less of the evaporator is being used to do useful work, *i.e.* the evaporator is starved.

Fig. 43c shows the use of the equalizer line on the same pressure drop as in fig. 43b. The pressure at the end of the evaporator is now transmitted back to the prime mover and therefore compensates the pressure drop. Comparison of the pressures and temperatures in this case will actually show 12° F. superheat and not 10° F. This is because the valve is a straight charged type and gives increasing superheat characteristics as pressure falls. Such a small change could easily be remedied by adjusting the superheat spring load.

Fig. 43d shows the salient points of installation of an expansion valve. The phial should only be affected by the superheated vapour, avoiding liquid traps and rapid changes of section of the pipework, and be so located that refrigerant vapour cannot by-pass the pipework to which the phial is attached. A falling suction main is to be preferred but if it has to rise it should be shaped as in the diagram. It will be noticed that the equalizer line connexion is downstream of the phial; this helps sensitivity and is to be recommended.

Phials should be mounted on top of the pipework except where the phial diameter is very small compared with the pipework; in this case, slightly below the centre-line of the pipe is to be preferred. In all cases, lagging of the assembled phial helps response by ensuring that the phial picks up the temperature of the pipe and is not affected by other temperatures. Such lagging must be moisture resistant and non-absorbent.

Where heat exchangers are used between liquid and suction the phial should be located on the evaporator side. Equalizer line valves should always be connected as illustrated and on no account should they ever be sealed off with caps or control will be lost.

The thermostatic expansion valve is widely used on all forms of compression refrigeration machinery because of the very wide range of control and characteristics which can be exploited to give specific performance requirements. In selecting any valve the first consideration is the capacity requirement for the given conditions and refrigerant. Manufacturers' tables provide the necessary data for the choice of valve, but a valve should never be deliberately chosen over-size. If a choice has to be made between two valves, one over and one under capacity, the latter will generally give better control. Particularly is this so when valves are rated on a 4° F. superheat change, because a further 1° F. will increase capacity by some 20 per cent., and in all but the most critical applications the extra degree will not represent an appreciable capacity penalty.

Normally, the capacity of an expansion valve is calculated for saturated liquid at condensing pressure at its inlet, and saturated vapour at the evaporator pressure leaving the evaporator.

The capacity is reduced by the following effects:—

(*a*) Pressure drops occurring in the liquid line due to pipe friction, driers, magnetic valves, stop valves and the expansion valve itself.

(*b*) Because of these pressure drops, unless the liquid is sub-cooled to a certain extent, vapour will tend to form in the liquid line and this will further reduce the capacity of the valve.

(*c*) If the valve is situated in a high position in relation to the liquid receiver a pressure drop due to liquid lift will occur and this may be further aggravated by vapour flashing off.

(*d*) Pressure drops in the evaporator due to friction where an equalizer connexion is not fitted.

The capacity of an expansion valve is increased by the following factors :—

(1) Cooling of entering liquid either naturally or by means of a heat exchanger when used on a Refrigerant-12 plant.

(2) Superheating of vaporized refrigerant.

Expansion Valve Troubles

Moisture. By far the most troublesome item is moisture. This may exist in free form or in combination with the refrigerant. Free moisture will not as a rule bring the plant to a standstill until it reaches the low side of the orifice in the expansion valve where at temperatures below 32° F. it freezes and can cause the valve to block or stick open or shut. Refrigerant will carry a certain amount of water in solution with it and as the temperature of the refrigerant drops so the quantity of water which can be held in solution drops. This means that although the refrigerant in the evaporator is below 32° F. water can still be circulating with the refrigerant and not cause trouble until a really low temperature is reached.

No useful purpose is served by warming the expansion valve to clear the moisture without changing the drier. The water merely enters the evaporator and freezes and then vaporizes as a fog (it sublimates) to return to condenser and again to the expansion valve and cause further blockage. It may be argued that the drier will pick it up on the way round, but the fact that it passed the drier in the first place seems to indicate that a new drier is required.

Moisture also tends to cause the formation of acids in the system and these can cause plating effects on monel needles and other parts of the valve but with the "Freons" these effects of moisture are secondary to the freezing and blocking which are a much earlier symptom.

Dirt. Because of the orifice size and working tolerances of moving parts, dirt readily affects the expansion valve. This is another reason why a filter drier is desirable in a plant even though filters are fitted to the valve.

Wax. At low temperatures mineral oil will deposit a waxy substance. If poor quality oil is used at low temperatures it is possible literally to "gum up the works" on an expansion valve.

Valve Hammer. This is associated with designs where the liquid flows over the needle and through the orifice. A similar effect can be observed by holding the plug near the outlet when a bath is being emptied. As the plug nears the outlet it is snatched onto its seat whilst at some distance from the outlet no effect is felt. This effect does not occur in an expansion valve unless the needle operates very close to the seat and only arises when :—

(*a*) The valve is considerably oversize.
(*b*) The superheat has been reduced to too low a value.

Trouble Shooting

In all fault analysis it should first be ascertained that the compressor is working effectively and the valve is of the correct capacity and characteristics for the duty. A check of phial location, fitting and insulation is to be recommended as a preliminary, if convenient. Pressure control or thermostat setting and differentials should also be checked.

Symptoms	*Remedy*
Insufficient refrigeration, evaporator only partially effective or valve not opening.	Lack of refrigerant—check with sight glass in liquid line, confirmed if valve hisses. Recharge and check for leak. Superheat setting on valve too wide —check pressures and temperatures. Reset. Capillary touching evaporator (particularly gas-charged valve). Check only phial is in contact. Phial mounted on liquid trap—resite. If frosting on inlet nut, blocked filter—clean or replace. If refrigeration not increased by warming head of valve, then phial, valve has lost charge—replace. If this warming opens valve then can be gas-charged valve which has reversed. Select and install different type of valve or resite head of gas-charged valve to warmer point. If liquid-charged valve, may be losing charge—replace. If associated with unintentional and alternate frosting and defrosting. Moisture. Fit drier. If valve does not meet any of these points—may be choked. Clean or replace.
Hunting	Check phial location and quality of thermal contact, particularly liquid traps in suction line. Resite phial and thermally lag. Oversize valve or superheat set too fine. Replace or adjust accordingly. Hammering of valve may only be bad case of these faults. On pressure-switch-controlled plant giving short cycling, check differential setting. If correct, valve leaking during off cycle of compressor—replace. If associated with frosting on inlet of valve, choked strainer. Clean or replace. If plant runs normally, then suction falls and plant defrosts, then again runs normally. Moisture—fit drier.
Flooding back to compressor	Valve oversize, check plant and refit more suitable valve. Superheat set too fine. Check temperatures and pressures and adjust. Poor phial contact, clean, refit and thermally lag.

(*Concluded*)

The Institute of Refrigeration Bulletin

Institute Headquarters: New Bridge Street House, New Bridge St., London, E.C.4 (CENtral 4694)

JANUARY MEETING

AT a meeting of the Institute to be held at 5.30 p.m. on Thursday, January 8, 1959, at the Institute of Marine Engineers, The Memorial Building, 76 Mark Lane, London, E.C.3, Dr. G. G. Haselden, B.SC., associate member, will present a paper entitled "An economic evaluation of large ammonia absorption refrigerating machines."

The purpose of the paper is to reconsider the place of ammonia absorption refrigeration machines as compared with vapour compression machines for large scale use particularly for applications in the chemical industry. Emphasis is placed on the evaluation of capital cost.

An outline is given of the economic design of machines for duties of 1,000,000 and 5,000,000 B.t.u. per hour at evaporator temperatures of 0, –30 and –60°F. The design of individual components is considered, drawing on data available from the Chemical Engineering Department of the Imperial College. An estimate of the capital cost of the complete machines is then attempted and this information is presented together with the steam and cooling water requirements. Some comparisons with vapour compression machines for the same duties are then made.

ANNUAL DINNER

The 59th anniversary dinner of the Institute will be held at the Savoy Hotel, London, on Wednesday, January 28, 1959.

Full details and forms of application on which to apply for tickets have already been forwarded to all members.

THE PRESIDENTIAL ADDRESS

In the hall of The Institute of Marine Engineers, London, last month Sir Rupert De la Bère, Bart., K.C.V.O., delivered his presidential address before members of The Institute of Refrigeration.

The following report constitutes a slight abbreviation of Sir Rupert's full text :—

I hope you will feel that I have been justified in departing from the usual practice of my illustrious predecessors in the office of president.

It is, as you are aware, always the custom to address the meeting on the subject of refrigeration, but I have chosen as my subject the Corporation of the City of London—the City of London, one of the greatest cities in the world, nay, still the greatest city in the world, and I am indeed proud to have been privileged to be the first citizen of this great city for one year—the coronation year of 1953.

1. **General**

No account of the Corporation of London would be complete which did not take a brief glimpse at its history.

(*a*) A.D. 61 Londinium is described as a town of the highest repute and a busy emporium for trade and traders-Annals of Tacitus.

(*b*) Leaping forward a 1,000 years to the period 1068 to 1075, the Conqueror granted to the citizens of London a charter which still exists—"William, King, greets William, Bishop, and Gosfrith, Portreeve, and all the Burgesses within London, French and English, friendly. And I give you to know that I will that ye be all those laws worthy that ye were in King Edward's day." This was the beginning of a long series of charters granting amenities and privileges.

(*c*) 1191, the Crown recognized the right of the citizens to combine into a sworn association to take an oath to preserve the city and its liberties. This was the granting of the "commune." 1193, looking for a name for an entirely new officer at the head of the corporation, the French title of mayor was adopted. The mayoralty was confirmed by charter in 1215 a few weeks before Magna Carta, at the signing of which the mayor was present. The charter required that the person elected as mayor should be presented to the king or his justices for approval and should swear fealty to the crown. There is no charter of incorporation—the corporation is incorporated by prescription and the development of the corporation is in the hands of the corporation itself.

2. The governing body comprises the lord mayor, 25 other aldermen (one representing each ward) and a number of common councilmen which is in process of reduction by the court itself, following war damage, to 159 members.

3. **Lord Mayor**

In local government generally, the mayor of a municipality is elected by the council from amongst its own members, or from those qualified to be members. In the City of London, the lord mayor is elected by the livery in common hall who are summoned by precept from the lord mayor to all the livery companies requiring them to give notice to their liverymen to attend at Guildhall on September 29th. The beadle of each company is required to attend also at Guildhall to prevent any other than liverymen from entering. The livery nominate two names for the final choice of the aldermen. It should be noted that before a citizen can attain to the office of lord mayor he must submit himself to election on three occasions and finally to scrutiny by the court of aldermen.

4. **Sheriffs**

These are the oldest of all our city officers. Up and down the country sheriffs collected the king's revenue and enforced royal justice. It followed that to be emancipated from the control of the royal financial agent must have been a real municipal privilege and we find the city having the right to appoint the sheriffs of London and of Middlesex in the 12th century. The right of the citizens to appoint the sheriffs of Middlesex continued until 1888, since when the city still appoints two sheriffs—but for the City of London. They are elected on midsummer's day.

The duties of the sheriffs are multifarious and incessant. They are expected to attend the lord mayor in the discharge of many of his official functions and to join with him in works of charity and occasions of hospitality. Judges into court and upon the first day to accompany the lord mayor and recorder. Generally, both sheriffs are present when the king's bench judge makes his first appearance and on other ceremonial occasions. A sheriff should also be present when a capital sentence is passed.

5. **Aldermen**

The office of alderman is one which goes deep into the roots of English history. Elsewhere in England, aldermen are elected by the town or county council, as is the mayor, from amongst their own members, or from amongst those who are qualified to be councillors. They hold office for six years, normally one half retire every three years.

In the City of London it is quite different. The aldermen are elected by the electors in the wards themselves, and they hold office for life. They are, by virtue of their office, the magistrates for the City of London.

6. I shall come on shortly to deal with the functions of the Corporation of London, but for the moment suffice it to say that the aldermen and the common councilmen, meeting as they do twice a month in Guildhall under the chairmanship of the lord mayor and organizing themselves into functional committees, is conducted pretty much on the same lines as any other council. So far as committees are concerned, the main committees are appointed on a ward basis. There are about 30, which is about the same as the average county borough, although they are different functionally.

7. Before, however, dealing with the various functions of the corporation, I would like to refer to the quite unique position of the corporation, which functions although, as one corporation, in *three different capacities* :—

(*a*) Firstly as an ancient municipality the Corporation of London carried out civic functions long before the Municipal Corporations Act and the Local Government and Public Health Acts (which have come in such profusion during the last hundred years) came into being. It is not unique in this respect—so did many others of the ancient municipalities. It was not, however, deemed necessary to reform the Corporation of London in the 19th century, as was done with all the other municipal corporations, and it still, therefore, functions as an ancient municipality and has available for that purpose, funds which arose originally from lands and revenues which had been confirmed or granted by charter to the citizens of London for many centuries, and in 1444 there was confirmed to them, " All soils, commons, purprestures and improvements in all wastes, commons, streets, ways and other places of the City, together with the profits of the same, and they may improve and enjoy the rents of the same for them and their successors for ever," and in 1638, Charles I confirmed " to the mayor and commonalty and citizens all houses, messuages and edifices and their site and foundation and all watercourses, gutters and easements which now are erected, built or enjoyed in, upon or under any void grounds, wastes, commons, streets, ways or public places, and in the banks, shores and waters of Thames." The rents from the modern buildings erected on the sites of these common lands, together with freedom fees and income from the markets, produce an income known as city's cash, which enables the corporation to carry out functions which would otherwise be a charge upon either the taxpayer or the ratepayer.

(*b*) Secondly, the corporation is the trustee of the Bridge House Estates. All the road bridges that connect the city with the southern banks of the Thames are owned and maintained by the corporation, and their rebuilding, maintenance, watching and cleansing is met from the income of property known as the Bridge House Estates. Four Bridges—London Bridge, Blackfriars Bridge, Southwark Bridge and Tower Bridge, are maintained by the corporation at no cost to either the ratepayer or the taxpayer.

(*c*) Thirdly, the corporation also functions as a modern local authority carrying out for the City of London certain functions of local administration under the authority of Acts of Parliament, just as is done everywhere else in the country.

(*d*) It must be remembered that although the Corporation of London is the governing body primarily for the square mile, its activities range far beyond there. Epping Forest, Highgate Wood, Burnham Beeches, and Coulsdon Common are open spaces entirely maintained by them outside their area. They are the Port Health Authority for the Thames from Teddington to Gravesend. Their markets at Smithfield, Billingsgate, Spitalfields and Islington serve the whole of greater London and beyond. The influence of the mayoralty, especially in time of disaster, is nation wide.

(The president then gave a review of the Central Markets, the Islington Cattle market, Billingsgate, Leadenhall and Spitalfields markets).

EDUCATION—CORPORATION SCHOOLS

The Corporation of London is not a statutory education authority, but has managed schools for over a century and now runs as independent schools out of its own funds, the City of London School, the City of London School for Girls and the Freemen's School at Ashtead, in addition to the Guildhall School of Music and Drama.

IMPROVEMENTS AND TOWN PLANNING

In the course of the Second World War the City of London suffered grievous losses of lives and property.

Four hundred and seventeen high-explosive bombs, 13 parachute mines, 24 oil bombs, many thousands of incendiaries, 17 flying bombs, and 1 rocket fell on the " square mile." The high altar and reredos of St. Paul's Cathedral were destroyed and 20 churches completely burnt out. The council chamber and the aldermen's court room, together with the art gallery and most of the public and private offices of the corporation were obliterated. Many of the livery companies' halls were completely destroyed. Few warehouses or offices in the congested Fore Street and Cripplegate areas escaped the incendiary raid on the night of 29/30 December, 1940 and large areas were obliterated on the night of 10/11 May, 1941.

By the Town Planning Act of 1947 the London County Council became the local planning authority for the " square mile," but the corporation was placed in a special statutory position. Before they have power to deal with planning applications they must seek the agreement of the London County Council as to the general manner in which they propose to deal with them.

Licensing is now at an end, but during 1954 licences were granted to the extent of £25,000,000. Some £10,000,000 has been expended by the corporation land acquisition for planning purposes.

PORT OF LONDON HEALTH

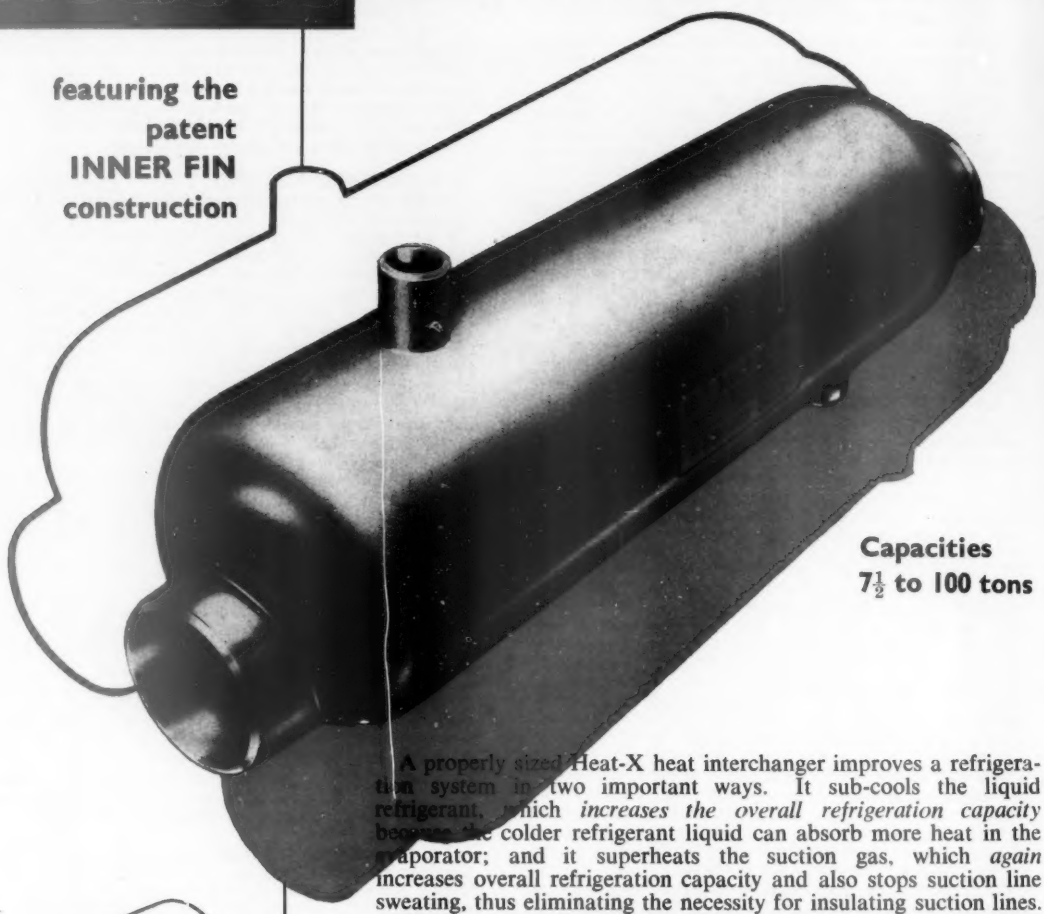
The corporation was originally constituted the sanitary authority of the Port of London by sec. 20 of the Public Health Act, 1872, and the limits of the port were defined to be those of the port as established for the purposes of the Customs laws. Full powers for the authority were not obtained until the passing of the Public Health (London) Act, 1891.

The present limits of the Port of London, as established for the purposes of the laws relating to the customs of the United Kingdom, were defined by Treasury minute dated August 1st, 1883 to commence " at high-water mark in the River Thames at Teddington Lock, in the County of Surrey, and extend down both sides of the river Thames to an imaginary straight line drawn from the pilot mark at the entrance of Havengore Creek, in the County of Essex, to the land's end at Warden Point, in the Isle of Sheppey, in the County of Kent, and to extend up and include both sides of the river Medway."

I believe in my country. Obviously each one of us does, but how often do we say so—seldom—it is our natural reticence, and yet our country is still the greatest and richest in experience, able to make a tremendous contribution to the problems which confront the world. Nuclear power and material progress have only added to these problems. Members of this Institute, and indeed the public throughout the country, are somewhat inclined to sit back and say that only the Government can solve the problems. This of course is true, but they the Government must have the weight of public opinion behind them, without which no real progress can be made, and it is the duty of each one of us to assist and ensure and enforce by the weight of public opinion that action shall be taken by the Government of the day.

heat-X HEAT INTERCHANGERS

featuring the patent INNER FIN construction

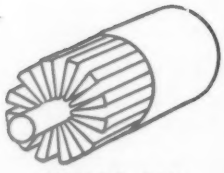


Capacities 7½ to 100 tons

A properly sized Heat-X heat interchanger improves a refrigeration system in two important ways. It sub-cools the liquid refrigerant, which *increases the overall refrigeration capacity* because the colder refrigerant liquid can absorb more heat in the evaporator; and it superheats the suction gas, which *again* increases overall refrigeration capacity and also stops suction line sweating, thus eliminating the necessity for insulating suction lines.

There are many more practical advantages to be gained from Heat-X interchangers, with their specially designed inner fins. We will be pleased to supply full information.

WRITE FOR BULLETIN HX/1004



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DUNHAM-BUSH

HEATING AND COOLING

SPEEDY CONSTRUCTION OF FROZEN FOODS STORE

IN our September issue the considerable, contemplated increase in low-temperature storage facilities in the ports of Grimsby and Hull was mentioned. As part of this programme, Eskimo Foods Ltd.'s new £120,000 cold store at Walcott Street, Hull, was completed last month.

The new building is to be used by the firm as a general cold store in addition to accommodating the products from their factory in Strickland Street, Hull.

Goods for storage will be delivered by lorry. Space is provided for three vans to be loaded or unloaded at one time at the entrance to the store. From the working area the goods are handled by fork reach trucks into the ground-floor cold chambers, or taken by a lift, capable of carrying 2 tons, to the first-floor chambers and stacked by hand.

Provision is also made for the delivery of wet fish which is frozen in two plate freezers in the ground-floor working area before being placed in the store.

The openings to the chambers are positioned off-centre so that the depth of storage each side is varied to accommodate the standard 4-ft. by 3-ft. 4-in. cartons in large or small quantities. The height of the openings is governed by a 30-cwt. fork reach truck on the ground floor and is 6 ft. for hand stacking on the first. Within the stores the height of the ground-floor chamber is 16 ft., plus allowance for the cooling coils, while the first floor is 8 ft. plus coils. Temperature is –20° F.

To the left of the entrance are stairs leading to the first-floor chambers in front of which are situated the working area, store manager's office, general office for six assistants, lavatories for cold store workers and office staff, kitchen, messroom and drying room for cold store workers' clothing.

The Cold Chambers

The chambers are constructed as two independent steel-framed brick envelopes, against which the insulation is fixed. Inside each an intermediate flat concrete floor slab, without beams, is supported on columns free of the walls so that the insulation carries up the walls for the full height past the floor. This eliminates insulation between the upper and lower chambers.

Each store incorporates the latest methods of temperature control, air circulation and defrosting, and is laid out to provide the maximum storage space. The temperature is maintained at –20° F. (52° below freezing) by thermostats which control the refrigerant to the coils and the compressors.

Along the main trucking aisle each store is lit by fluorescent tubes specially designed to operate at –20° F. The lighting scheme is arranged to give a high intensity at the farthermost point and takes advantage of the reflectivity from the snow formation on the refrigerated coils. Each chamber has emergency alarm equipment, to be operated by anyone accidentally shut in.

At each entrance, the Miniveil system is fitted. The doors themselves are provided with an electric heating element around the edges and across the threshold, which comes into operation when closed to prevent the doors being locked by ice. It is believed that this heater system, on all *four* sides, is unique.

The refrigeration plant consists of two independent ammonia plants each capable of cooling one pair of chambers, one above the other. Each plant is completely automatic and consists of one 60 h.p. compound compressor, one economizer condenser, one liquid receiver and one vertical mounting surge drum. Two pumps deliver liquid ammonia at –35°F. to the ceiling grids in each chamber. Two Williams contact plate freezers are served by one 120 h.p. compound compressor complete with economizer condenser, liquid receiver and vertical mounting surge drum. Two pumps deliver liquid ammonia at –35°F. to the freezers. The freezers have a capacity of 10 cwt. per hour each when handling fish in bulk packs. The complete refrigeration plant is provided with cross over connections for standby purposes. G. Williams Engineering Co. Ltd. designed, manufactured and erected the complete plant.

The brickwork of the building is rendered internally and a bituminous compound applied as a vapour barrier. Against this are fixed two 4-in. layers of cork blocks breaking joint and bonded together with bitumen. The outer layer is protected from damage by the pallets with a further cement rendering and large timber dunnage battens on a concrete curb. This also provides a space between the cartons and the wall for the passage of refrigerated air.

The ground floors are similarly insulated, except that on the insulation is laid 4 in. of carefully mixed and power-floated granolithic concrete on which is painted the location of the pallets. Beneath the insulation there is an automatically controlled electric blanket to prevent the sub-soil freezing and heaving up the floor.

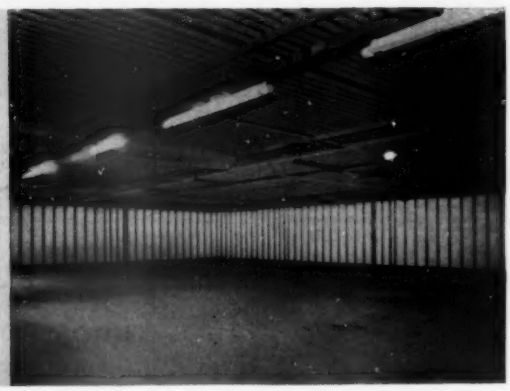
The ceiling insulation is fixed direct to $\frac{3}{4}$-in. high-quality chip board on timber joists, supported on the bottom of the roof trusses. Through these joists are also bolted the hangers for the cooling coils below, each packed around and above with insulation, to prevent the penetration of heat from the roof space. C. L. Whitaker & Co. Ltd. carried out all the insulation work.

The Minikay system of dehydration has been used throughout. Horizontal air ducts are formed in the insulation through which dehumidified air is blown, thus absorbing any moisture which has penetrated the vapour barrier and thus preventing the formation of ice in the insulation and prolonging its life.

The design of the store was commenced in August, 1957. Planning permission was received in September and tenders were obtained in October. Work started on site the same month. To comply with the rapid construction programme required, a steel-framed building was necessary with brick walls. Each of the stores is 63 ft. by 77 ft. deep with a total capacity of approximately 1,000 tons.

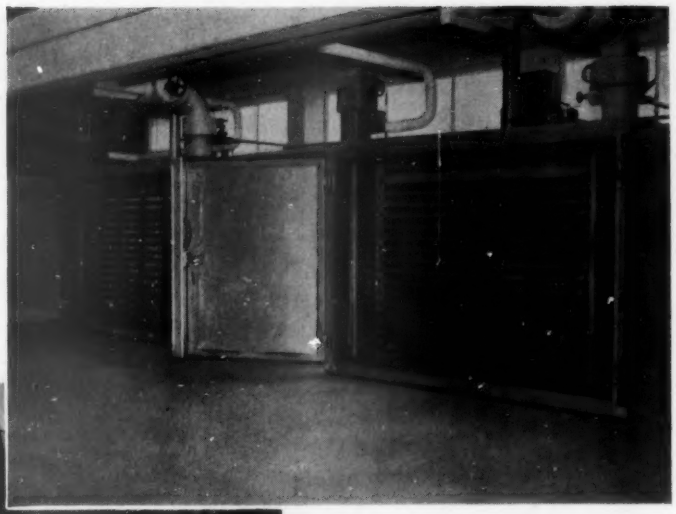
Engineer to Eskimo Foods Ltd. is Mr. R. T. Marshall. Consulting engineers and architects for

Two of the very commodious chambers at Hull.



the new cold store were Messrs. Jenkins, Manning, Potter and Clamp. Messrs. Monk and Dunstone were the quantity surveyors and the general contractors were Messrs. L. H. Beal Ltd.

Contractors :
Refrigeration plant : G. Williams Engineering Co. Ltd.
Compressors : L. Sterne & Co. Ltd.
Insulation : C. L. Whitaker & Co. Ltd.
Cork for the insulation : Cork Growers Trading Co. (1931) Ltd.



Lifts : Evans Lifts Ltd.
Electric mats : Panelec Ltd.
Fork reach trucks: Conveyancer Ltd.
Transporters : Yale & Towne Ltd.

Above: Williams contact plate freezers.

Left: The door frames have heating elements on all three sides and across the threshold.

SHOP REFRIGERATION NEWS

WELWYN GARDEN CITY IS STILL DEVELOPING

WELWYN Garden City has been the scene of almost continuous development since the war and one of the latest buildings to be constructed in the town centre is the large two-storey departmental store of the St. Albans Co-operative Society. Situated in Stonehills, one of the busiest streets in the area, it is already proving a major attraction on account of its wide range of commodities—everything from costume jewellery to the latest kitchen sink unit —and its spacious modern layout.

One of the principal attractions is the food department on the ground floor. This has, in point of fact, taken the place of a traditional service grocery and butchery which the Co-operative Society had a few blocks away in Housegate, another busy shopping thoroughfare, and which has now been converted into an order department for their wholesale office.

The area of the new food hall is double that of the old butchery and grocery shops put together, but this increase is mainly in the size of the space given over to groceries since the butchery section is much the same as before. It is significant that despite this unchanged selling area and the fact that the same team of three butchers and one

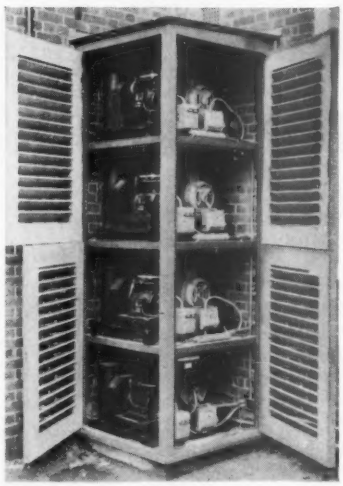
The transformation of the meat hall on to a self - service basis has resulted in a sales increase of 25 per cent in the space of a few weeks.

assistant still operates, butchery sales have increased by 25 per cent. in the few weeks that this store has been open and operating on a self-service basis.

All meat is cut and prepared then weighed and prepacked on the premises at the back of the store. It is then displayed in the two Hussmann refrigerated display cases which comprise the butchery section. The main refrigerated counter, which is 18 ft. long, lies along the back of the food hall, attention being drawn to the display by a brilliant green canopy over the refrigerated run with the words " Fresh Meats " picked out in white. The entire 18 ft. of this cabinet is devoted to the sale of prepacked English meats. Imported meats are displayed in a further 9-ft. run of Hussmann refrigerated display cabinet, situated along the adjacent wall.

There is no definite boundary between the butchery and grocery sections and since the purpose when planning this store was to keep all refrigerated display sited in one area, a 24-ft. run of island site Hussmann provisions and frozen food case completes the perishables section and leads the shopper naturally from one department to another. Of the 24 ft. of refrigerated display in the grocery section, 18 ft. is devoted to dairy produce and cooked meats and 6 ft. is for frozen foods. This is the first time frozen foods have been sold by this branch and results to date are extremely encouraging. Three rows of gondolas running parallel with the 24-ft. refrigerated provisions case complete the grocery section together with the shelving lining the walls, allowing the customers five wide shopping aisles and giving the store a compact, well-planned appearance.

The enlargement of the grocery section has, in addition to affording the customer a far greater degree of comfort plus the convenience of self-



The grouping of the condensing units in this way has resulted in a most business-like and space-saving installation.

service, enabled the grocer to stock more lines and has resulted in an increased turnover over the previous grocery department of approximately 75 per cent.

In addition to the usual dry goods and groceries, there is also quite a large prepacked fruit and vegetable section, packs being displayed on small attractive gondolas, specially designed for this purpose by the Watford Co-operative Society's works department, as are all the shop fittings in this store. This section is also proving a great success and will probably be enlarged to meet the increasing demand.

Décor is light and cool ; the blue ceiling is broken up by white beams and pillars, the other predominant colour being a fresh shade of green, in which all gondolas and wall shelving are faced. The floor is also green tiled ; refrigerators are finished in white.

The total effect is a cool, streamlined and uncluttered store wherein the customer can obtain all her shopping requirements under the most hygienic conditions and with the minimum delay and maximum comfort. The success of this venture to date clearly indicates how well these factors are appreciated.

FOOD DISPLAY

" Vizusell " is a flexible shopfitting system for displaying the maximum amount of merchandise to the customer in the minimum space. It combines with ease of assembly and lightness, great strength and weight-carrying capacity. " Vizusell " is adaptable for displays on existing walls, counters, tables, island units, gondolas, or for entirely new installations. Basically, this new yet already established method for fitting out the interior of shops, consists of channels and brackets into which wall panels, partitions and shelves can be fitted. It has also manifold uses in the construction of island units and gondolas. Shelves supported on " Vizusell " brackets can be of any material the shopkeeper selects—wood, glass, fibre-board and metal being those most used, and there is a wide range of the types and sizes of brackets that can be fitted into the channels, from brackets capable of carrying a ton of goods, to powder puffs. " Vizusell " is made of steel and is normally finished in silvertone, but there is a wide range of finishes to suit the customer's individual choice. When assembled " Vizusell " has exceptionally clean and simple lines.

New Scottish Installation

THE steady development of self-service operation in the food trade has encouraged the conversion of many older properties to this new system and is now leading to the construction of completely new buildings, designed primarily for this purpose.

Where the project is completely new and where space is available for adequate expression of ideas, opportunity occurs for the effective creation of tailor-made buildings.

Less scope occurs where conversion is involved and relatively little of note has matured in such units in Scotland.

The newer food halls in the housing scheme areas do, on the other hand, provide a picture of " ideas in action." The older conception of retailing visualized a series of small departmental units, even where the ownership or control was centralized. That conception has been completely killed by present-day costs. The opening of a modern meat shop could involve something like £15,000 with a weekly oncost of wages, according to staff involved. Separate fruit, fish and bakery units, while less costly, are equally uneconomic to-day.

Modern Alternative

The food hall is the modern alternative and some very attractive examples have been opened in recent months. Layouts, selling techniques and other factors naturally decide the form which the food hall will take ; these in turn are decided by managerial policy.

A good example of a very modern food hall is offered at Faifley, a new suburb of Clydebank, where there is a population of 5,000. There Clydebank Co-operative Society have built a single-storey functional modern-style food hall with a frontage of approximately 94 ft.

The self-service hall measures 72 ft. long by 36 ft. wide and is a completely naked rectangle, the entire front wall being occupied by plate glass and a limited display frontage at low level.

The three remaining walls are clad with five-deck metal self-service fixtures, each section being identified by commodity tabs above the section.

" Prestcold " Unit

The only unit on the terrazzo floor is a central 37-ft.-long refrigerated open top " Prestcold " Parade unit—the ideal medium for handling prepacked meat, prepacked cooked meat, prepacked fish, frozen foods and fats.

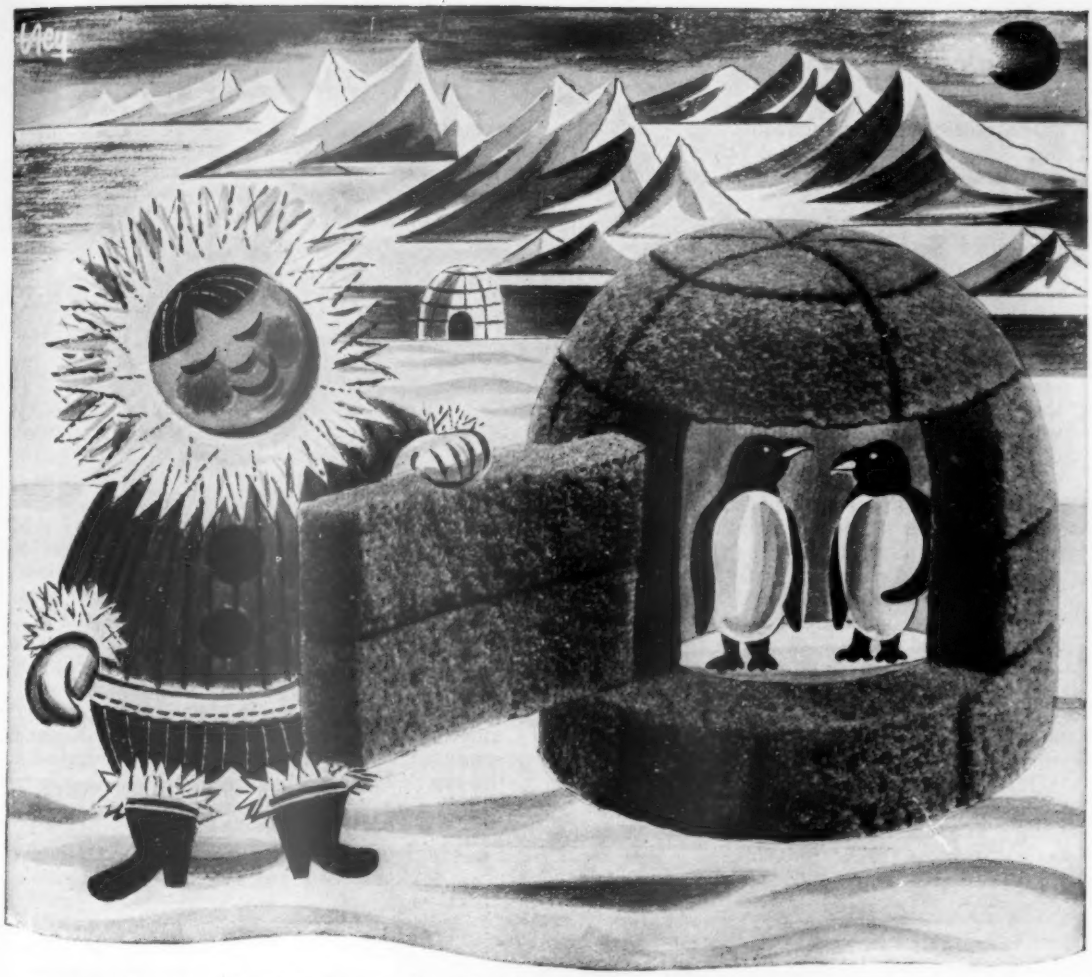
The " Prestcold " unit—at 37 ft. long probably the largest of its kind in Scotland—has a "Formica" front and is equipped with automatic defrosting. The case consists of a 6-ft. display for frozen food, 12 ft. for fresh prepacked meat, 12 ft. for cooked meats and dairy products, and 6 ft. for eggs. All these sections have different temperatures.

Specially designed for maximum sales, the " Prestcold " Parade sales-case embodies all the essential features necessary for successful selling. Its attractive contemporary design immediately catches the customer's eye, the entire display is illuminated and can be seen through the big multi-glazed window. The contents are obvious and because it comes into operation regularly each day it maintains top-level refrigerating efficiency, thus keeping all produce in perfect condition.

" Show more to sell more " is a maxim which

A corner of the Clydebank installation described above.

(This picture was inserted erroneously in the article in October relating to Cooper and Company's new branches in Scotland—ED.)



new insulation, light and strong

These simple-to-mix components give rigid foams to provide the refrigeration industry with a remarkable new insulating material that combines high thermal resistance with strength and lightness. Easily mixed on the site, the components produce the foam in the cavity to be filled. Foams of varying density can easily be made.

with Isocyanates and POLYESTERS by ICI

Ask for details of **Daltolacs 21, 22 & 24** and **Suprasec D.**

Enquiries should be addressed to:
I.C.I. Sales Development Department (Polyisocyanates), Ship Canal House, King Street, Manchester 2.

IMPERIAL CHEMICAL INDUSTRIES LIMITED LONDON SW1 ENGLAND D945

applies particularly to frozen foods and by installing this large " Prestcold " sales-case Clydebank Co-operative Society have insured maximum sales impact.

The " Prestcold " unit was supplied and installed by William Kemp & Co. Ltd. of Glasgow.

Running parallel with this refrigerated unit and with the front glazing is a long check-out counter which is used here in preference to the more normal system of barriers and check-out points.

The area to the rear of the self-service hall is used for stock and the central rear doorway leading into this is concealed by an overlap of the self-service wall fixtures which protrude to give cover to the doorway.

Advantages

This food hall is rather unusual but is based on experience over 10 to 15 years of work. The elimination of all floor " selling points," gondolas, and other stock-carrying display units and the somewhat prodigal use of floor space is intentional here, on the basis that they add nothing to selling scope in a sufficiently large unit and have the disadvantage of obscuring visual control of the floor and encourage pilfering.

The low-level central line of self-service refrigerated units replaces the older separate shops carrying meat, fish, and cooked meats, and can actually handle the same volume of business within each section as could be done by a fully equipped and costly specialized unit.

The advantage of maximum open floor space is demonstrated at peak selling periods when the wisdom of allowing ample space is clearly evident.

In the same way the Clydebank project has proved that a cash-out counter allows a much freer flow of traffic than the conventional check-out barriers used in so many self-service food halls.

Shoppers can select any point on the counter and staff can be added or withdrawn in keeping with the pressure on the long cash-out counter.

This very simple layout has been used now by Clydebank in many self-service units, converted and newly built, and has proved extremely successful in handling very large numbers.

Ultimate necessities in the modern food hall are ability to handle peak traffic, maximum freedom of access to merchandise shelves, maximum ease of identification of the various sections, and full visual control by management at every stage. These needs are met in the type of layout described above.

The essentially functional aspect of the structure is repeated in the exterior, which is on traditional lines.

Emphasis in such new food halls is on turnover, convenience to the shopper, and effective visual presentation. These are all effectively achieved in this large Clydebank unit.

The Prestcold "Double-Fronted" sales case.

Prestcold's New Display Cases

PRESTCOLD have introduced two new models in their range of " Parade " supermarket cases ; they are the Parade " Multideck " and the Parade "Double-Fronted" sales case. The "Double-Fronted" model supersedes the original island case, but when specially required the island model can still be obtained.

The new Prestcold Parade "Multideck" model which had its "première" at the London Dairy Show.

The Parade " Multideck " sales case is a unique British achievement. Without any apparent means of control, this new development incorporates a forced-air cooling system which cascades cool air over the shelving and lower display and forms an invisible sleeve which ensures that all packaged displays are kept in the best condition.

Maximum refrigeration capacity is maintained by automatic defrosting, and this case can be supplied in single units 8 or 6 ft. long or joined together in multiples. These features, together with its advanced contemporary design, make this sales case an ideal model for supermarkets and the like. The " Multideck " sales case provides automatically maintained temperatures for the display of prepackaged dairy produce, fruit and vegetables, cooked meats, etc. The two upper display decks are adjustable whilst the lower display deck is fitted with removable shelves and all of them are finished in white stove enamel. The external finish can be in white or in a range of colours as required. Stainless steel capping is fitted around the exposed edges of the end panels and adjustable feet are incorporated which are concealed behind the recessed plinth. The cabinets are cooled by the well-known Prestcold fully-automatic condensing unit which incorporates the permanently lubricated Super Presmetic motor compressor.

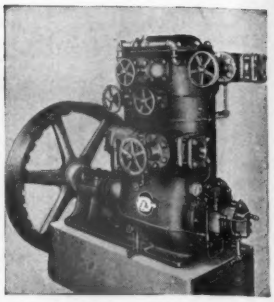
This model should be very attractive, not only to the retailer in that it has 28 sq. ft. of refrigerated display area per 6-ft. length and 37 sq. ft. for each 8-ft. length, but it presents a sparkling display on many levels to the customer.

The Parade " Double-Fronted " sales case has the distinct advantage that it can be placed in the middle of the floor space and attract the customer's attention on both sides. This case is also supplied in 6- or 8-ft. lengths and it can be joined together in multiples. There are three variations available, these being for dairy produce and meat, etc., general-purpose meat and frozen foods. Storage capacity for the first two is 16 sq. ft. on each 8-ft. length, while the frozen food cases have an approximate gross capacity of 12 c.ft. in the 6-ft. length and 16 c.ft. in the 8-ft. length. These cases, as with the " Multideck," can be supplied either white or primed ready for individual finish by the shop-fitters. The stainless steel capping and adjustable feet, with automatic temperature control and many other improvements make this model not only very advanced in design, but very advanced in operation.

The first Hussmann British refrigerated counter of its type to go into use in Scotland has been installed at Dunfermline in Fife by J. D. Bruce Ltd., old-established food merchants and restaurateurs. It is a quarter-circle unit, with automatic defrosting designed to show delicatessen items to advantage, as attractive from the rear as from the front since the counter is used at an open vision window, and with the motor unit located in the cellar below the premises. The idea for this unit was taken from a Swiss food shop where a completely circular refrigerated counter unit was seen at work. Space prevented such a unit here, since the equipment had to be fitted into an extra shop which the firm took over adjoining their bakery and restaurant premises. Decision was taken, therefore, to use a quarter circle unit and Hussmann British designed and supplied the equipment through G. A. B. Davidson Ltd., their Scottish distributors. Also included in this new section is a frozen food area, another innovation for this firm at these premises.

COMMERCIAL AND INDUSTRIAL SECTION

Manufacturers' and distributors' news



A new domestic refrigerator is about to be launched on the British market by **Elliott Domestic Appliances Ltd.**, an associated company of the well-known machine tool makers, B. Elliott (Machinery) Ltd., of Victoria Works, Willesden. Managing director is Mr. J. C. Fraser. It is understood that a start is being made with a small-sized absorption model, for building into kitchen fitments, for use on a stand or for wall mounting. Other models will be added later.

* * *

At the annual meeting of **Carrier Engineering Company Limited,** held in London, Mr. R. S. Andrews presided. In the course of his speech, the chairman said : " The gross trading profit is £864,450. The charges against this trading profit, with the corresponding figures for the previous year, are clearly shown in the accounts. The net trading profit of £792,000 is augmented by income from investments totalling £81,200 and interest on tax reserve certificates of £6,400. After taxation of £461,700 we have a net income for the year of slightly less than £420,000. The Carrier 'Weathermaster' system is being well received by architects and is particularly applicable to the larger type of buildings favoured by those engaged in building and property development. We expect to secure our full share of the expanding market for marine air-conditioning. We shall pursue our endeavours to maintain the lead we have achieved in the field of thermal engineering, in which we have accumulated a vast and valuable experience. Our research and development division continues to concentrate on the design and development of new products and the application of the latest technology to existing activities. Our factory equipment and methods of manufacture are maintained at a high level of efficiency. Executives of the manufacturing division have travelled abroad during the year for the purpose of studying new processes and methods."

* * *

A technical booklet describing the range of Rockite rigid extrusions has recently been published by **British Resin Products Ltd.** The extrusions, which are made from Rockite phenolic moulding materials, are produced in a wide variety of sections. They are available in any length, do not require polishing and are permanent in colour. They are also resistant to heat, chemicals, weathering and corrosion. Because of their unusual combination of properties Rockite rigid extrusions are being increasingly used in many fields including coachbuilding, refrigeration, office equipment and electrical accessories. The booklet has been designed to provide engineers and designers with all relevant data in readily available form.

* * *

Assemblies which require to be carried out in a dust-free atmosphere sometimes present a problem to the manufacturer. One solution is the use of special cabinets in which the assembly is performed and which have some means of excluding dust. Such a pressurized cabinet is made by **John Bass Limited** and marketed by B.M.B. (Sales) Limited, Boscobel, High Street, Crawley, Sussex. These leave the hands free from sealing gloves by supplying a stream of filtered air flowing from inside out.

The growing influence of British salesmanship in home and overseas markets was interesting news for Sir Miles Thomas when he visited the Directors' and Executives' Exhibition, London, recently. Left to right, Peter Randall (Tack P.R.O.), Sir Miles Thomas and Mr. John Wheatley, the exhibition organizer.

Problems solved from cold NO.1 IN A SERIES

By Appointment to Her Majesty the Queen
Manufacturers of refrigerating machinery
Pressed Steel Company Limited

How we helped Dunlop make a better Golf Ball

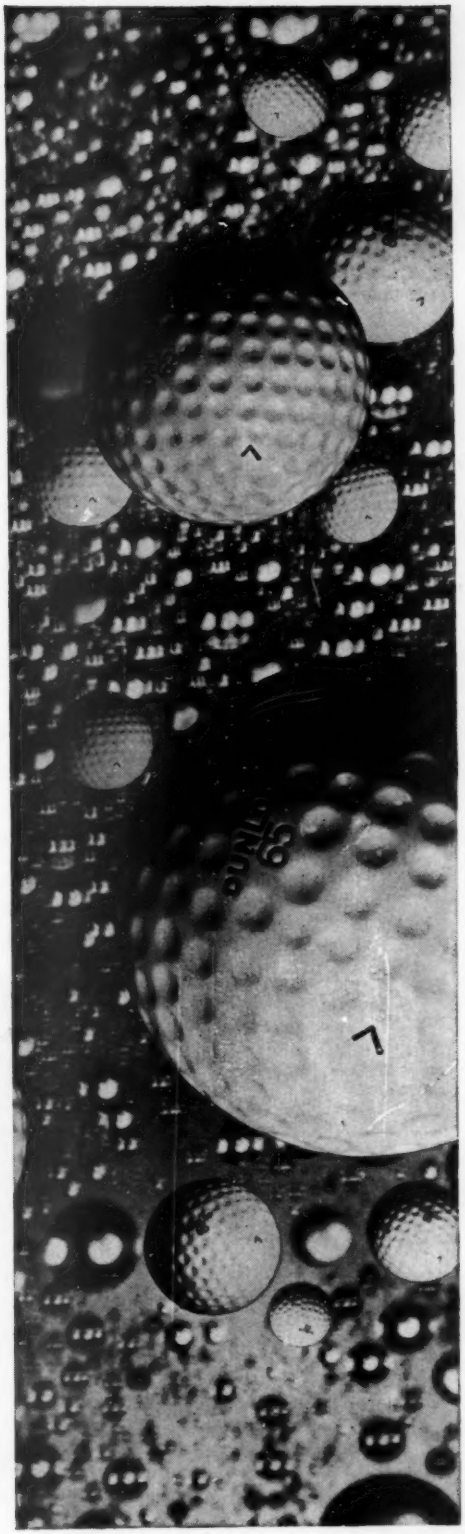
The core of the problem

At one stage in the making of golf balls the inner core has to be frozen hard. The purpose: to retain the exact proportions of the ball during the process of putting on the cover. Otherwise, the inner core would be too soft for handling and the ball might lose its perfect shape. Until 1954 the Dunlop Rubber Company used solid carbon dioxide for this purpose. They asked us at Prestcold if we could devise some more efficient and economical method.

Intense cold, controlled cold. The problem bristled with difficulties. True, we could produce the low temperatures easily enough; there are Prestcold appliances that go to extreme low temperature if need be. But intense cold is expensive. So to keep costs down we had to concentrate the cold in a very small area. And, of course, we had to make our plans fit the existing layout of the Dunlop factory.

The Prestcold solution. Our answer was to install a special blast freezer to direct a jet of very cold air at the cores. Low operating costs were achieved by our recirculating the low temperature air. Net result: a better golf ball, economically produced.

Can Prestcold help you? If you have a problem in refrigeration you'll probably find that existing Prestcold equipment will deal with it. Because all our equipment comes from a long line of intense research. But even if yours is an entirely unique problem please let us know about it. We shall be glad to help. Write to us or to your Prestcold distributor, or to Prestcold Commercial Sales Department, Cowley, Oxford.



FOR FRESH IDEAS...IT'S

Prestcold

PRESTCOLD DIVISION

PRESSED STEEL COMPANY LIMITED · COWLEY · OXFORD

In the manufacture of the roller of **Frigidaire's** " Meter-Miser " sealed unit, tolerances within plus or minus 0·0001 in. for thickness and within 3,000,000ths in. for surface finish are the order of the day. In fact, the final process of manufacture of the roller falls into two parts : first, grinding it to the approximate shape and size required ; then, giving it a flat, smooth, surface of highest quality. For this second stage the firm has recently installed the Newall Rigidlap Universal lapping machine illustrated on this page. As with all lapping machines a coolant must continually flow over the abrasive wheel and parts being lapped, to prevent excessive temperature rise or more accurately, to absorb and carry away the heat inevitably engendered. Now here is the problem, as it was presented to their sales engineering department. The coolant itself gets hot and gets hotter as the day wears on. Accordingly, it will gradually become less effective. As a test, the machine was used and the temperature of the coolant—paraffin in this instance—was recorded at regular intervals. When the test began at 10.30 a.m., the temperature was 70° F. By 12 o'clock it was 81° F. Despite a break for lunch it had only fallen to 78° F. when work was resumed at 1.30 p.m. By 3 o'clock the temperature had reached 93° F. Two facts emerged ; the temperature had risen by 23° F. within part of a working day, and even when the machine was not in use, natural cooling was very slow. If this were allowed to occur unchecked during production, precision lapping would be frustrated by the contraction that would take place afterwards. Precision in fact would be impossible. The Hydrolap machine which formerly did this operation, used running water to cool the paraffin. This was partially effective, but it was expensive, cumbersome, and did not provide automatic control of coolant temperature. Now, with the new Rigidlap machine, Frigidaire's have overcome these difficulties by using an MMH-4 condensing unit to cool the paraffin. The " Meter-Miser " unit working in conjunction with thermostatic control ensures a constant temperature at all times and for this purpose 68° F. has been chosen as the most suitable. Furthermore, the " Meter-Miser " brings a considerable saving of expense, as the cost of electricity consumed is negligible compared to that of running water.

* * *

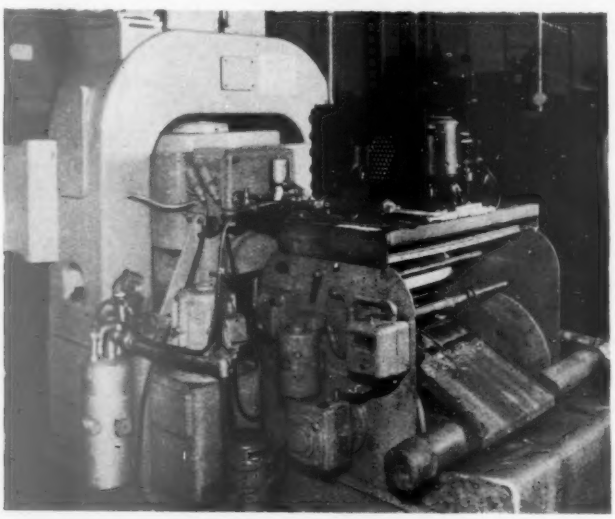
A new, adaptable range of remote control push-button equipment has been introduced by a well-known manufacturer of heavy-duty electrical control gear. Equally suitable for such diverse purposes as pump or machine tool control and lift or escalator operation, all items in the range are designed to conform to a new and flexible system—known as the " Dupar unit system." This enables many different components such as push-buttons, switches, round or rectangular indicator lamps, auxiliary contacts and audible indicators to be fitted into a control box of appropriate size. The manufacturers claim that not only will the system meet the requirements of almost every type of remote control application, but it is sufficiently flexible to embrace also non-standard parts if these are needed. A fully illustrated publication, incorporating a useful colour code, is freely available, on request, from **Dewhurst and Partner Ltd.**, Inverness Works, Hounslow.

* * *

In designing the range of **" Bassaire "** exhaust fans, the usual hydraulic principles governing fan performance were underlined by a full technical appreciation of the chemical and mechanical properties of unplasticised polyvinylchloride. The ultimate result is the "Bassaire" patented principle giving centrifugal performance with axial flow, combined with all-fabricated construction of a high standard. The impeller is constructed for maximum rigidity and full calculations take into account the "short- and long-term" stress life of u.p.v.c., a feature so often overlooked in the design of many ordinary plastic fans. Within an accurately machined, all-u.p.v.c., centre boss is a substantial steel hub and taperlock bush ; thus no locating grub screws are present which entail piercing the plastic material. The motor is flange mounted to a heavy support plate attached to the fan casing with the latest high impact u.p.v.c. bolts. This method permits the motor and impeller to be withdrawn as one unit.

* * *

The Frigidaire dehumidifier — model DH–1 — was released on November 24, as a standard Frigidaire product. It is designed to remove excess moisture from any unventilated, enclosed space of up to 8,000 c.ft. at a maximum rate of 16 pints of water in 24 hours, and to hold the relative humidity down to 55 to 60 per cent. in dry bulb temperatures of 65°F. and above.



The lapping machine at Hendon fitted with refrigeration facilities.

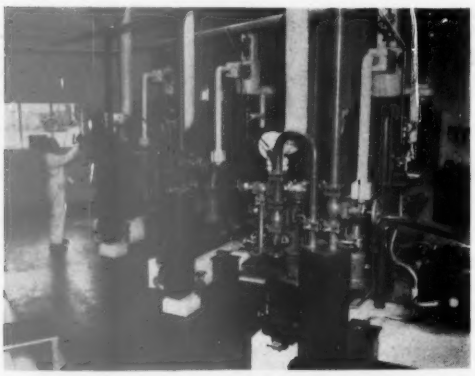
ROSS GROUP'S COLD STORE

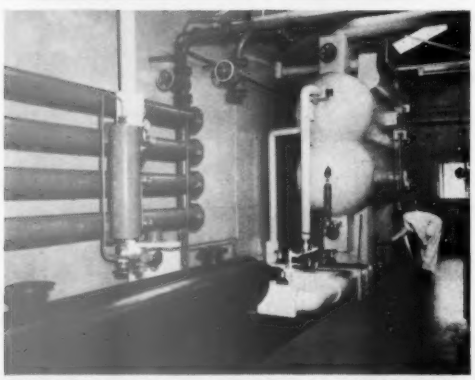
THE accompanying illustrations are of the machinery side of the cold store built for the Ross Group in Grimsby and described earlier in these columns.

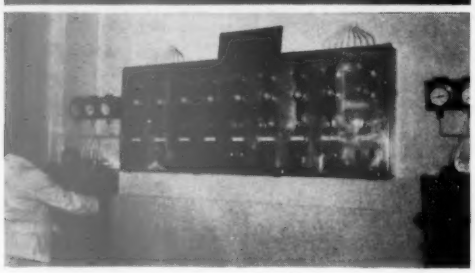
The three 9-in. by 6-in. by 6-in. compound ammonia compressors by J. & E. Hall Ltd. are each driven by a 40-h.p. electric motor.

The main electrical panel and switchgear is of Reyrolle manufacture.

Provision has been made for possible extension to this building The cold store would be enlarged by 5,810 sq. ft. and the engine room by 348 sq. ft. which would enable two more 9-in. by 6-in. by 6-in. compound compressors to meet the added duty.







J. & E. Hall in Australia

A FURTHER important step has been taken in expanding the Australian activities of J. & E. Hall Ltd., Dartford.

This concern, established in 1785, was originally represented in Australia by A.W.A. Some time ago an Australian subsidiary under the name of J. & E. Hall (Australasia) Pty. Ltd., with Mr. A. B. Thornton as managing director, was formed to handle marine and industrial refrigeration and air-conditioning business on their own account.

This Australian subsidiary has now acquired from Daniel Scott Industries Ltd. the share capital of Richard Wildridge & Co. Pty. Ltd. and Wilac Engineering Pty. Ltd., of Sydney, and of Richard Wildridge (Vic.) Pty. Ltd., of Melbourne.

J. & E. Hall (Australasia) Pty. Ltd. have announced their intention of continuing to operate these companies until their business can be integrated with their own organization after which the combined sales, manufacturing and service organizations both in Sydney and Melbourne will function under their own name.

The managing director of J. & E. Hall (Australasia) Pty. Ltd. said that the full scope of the new organization would cover every aspect of refrigeration design and application and would provide all services including erection and servicing for both land and marine installations. Special attention would be paid to all service work and to spare parts supplies and repairs to existing plants by J. & E. Hall Ltd., J. & E. Hall (Australasia) Pty. Ltd. and the Richard Wildridge companies, including Wilac Engineering Pty. Ltd.

In accordance with company policy, T. Wall & Sons Ltd. have decided to split their central buying department into two departments. One will serve T. Wall & Sons (Ice Cream) Ltd. and the other T. Wall & Sons (Meat & Handy Foods) Ltd. Mr. L. R. E. Pirkis, at present chief buyer to the group, has been appointed as chief buyer for the ice cream company and Mr. B. Holmes Pegler for the meat and handy foods company. He will be responsible to Mr. R. Swain, purchasing director of the meat and handy foods company. Both departments will remain at The Friary, Acton, London, W.3, for the time being, but within a few weeks the department serving the meat and handy foods company will be located at Atlas Road, Willesden.

BUYERS' GUIDE

Expansion Valve Testing

A NEW method of testing the expansion valve on an automotive air-conditioning system without removing it from the system has been released by P. B. Hopkins, director, service development and training, Chrysler sales and service training centre in Detroit. This centre is the home office, development section and nerve centre of all the new Chrysler training centres now opening across the nation, according to *Ansul News Notes*.

A compressor capacity and expansion valve super heat cap was developed at the Chrysler training centre in Detroit. Each cap is specially tested for the accuracy of its orifice. This accuracy is an absolute must. If an orifice is inaccurate, the test cap might indicate that a good compressor or valve was bad, or that a bad compressor or valve was good.

The test cap (Miller part No. SP2922) is available from the Miller Manufacturing Co., 17640 Grand River Avenue, Detroit 27, Michigan.

Note: This method of testing the expansion valve without removing the valve from the air-conditioning system was developed to be used on all air-conditioning systems factory installed or factory type package units installed in a dealership, for Chrysler Corporation vehicles from 1955 to 1958 inclusive.

This Chrysler method is applicable not only to automotive air-conditioning systems but, when modified, to test expansion valves on other types of equipment.

Heed a word of warning before using this test: First, make certain that the compressor is within specifications by making a compressor capacity test. The compressor must pass this test. Otherwise, the gas used to test the valve could be leaking past a compressor reed valve or a fractured head gasket from the discharge side to the suction side and, as a result, upset the expansion valve test. A step-by-step method for testing a compressor is detailed and outlined with illustrations in Chrysler air-conditioning service manuals.

OBITUARY

Mr. James A. Currie

We regret to record the death of Mr. James A. Currie, managing director of Currie & Thomson (Engrs.) Ltd., Frigidaire distributors for Aberdeen, in his 71st year.

"Jim," as he was affectionately known to everybody, was first associated with Frigidaire in the 1920s when he worked for their Edinburgh branch selling and then installing the plants he sold.

It was in 1928, when he moved to Aberdeen, that he met his future partner, William Thomson.

In 1935 they formed their own private company with offices first in Thistle Street and later in Thistle Place. Shortly after the second world war, Currie and Thomson became Frigidaire distributors in Aberdeen, the present company being formed in 1951.

There can be very few people in the north of Scotland who, during the last 30 years, have not come to know Jim Currie and who will not fail to remember him with affection.

He leaves a widow and daughter.

NEW PUBLICATION

Kaeltemaschinen Regeln (Refrigeration Rules). 5th edition. Deutsche Kaeltetechnisches Verein 11¾ in. × 8¼ in. VII + 95 pp and 15 loose charts in pocket. Plastic bound. 1958. (Published by C. F. Mueller, Karlsruhe. Price DM 29.

This is the fifth edition of the official German guide for refrigeration calculations and rules for testing refrigeration machines and installations issued by the German Refrigerating Association (DKV.) The first edition appeared in the year 1923, and the present revision is the work of a committee of 16.

As compared with the 4th (1950) edition it has been extended from 62 to 95 pages of which the text dealing with methods of testing and calculation are revised and extended from 19 to 46 pages. Notable changes are the omission of data on dimethylether $(CH_3)_2O$, dichlormethane CH_2Cl_2 and F_{31}, and the addition of text and three diagrams dealing with absorption refrigeration.

A useful reference feature is a three-page bibliography of German standards, codes, and of working charts.

FREEZING PLANT ABOARD FACTORY SHIPS AND TRAWLERS

★ **Although commercial adoption of new methods for freezing fish at sea is not so far advanced in the United Kingdom as it is in the U.S.S.R., it is fair to say that more experience is available in the United Kingdom on designing and operating all types of freezing plant for use at sea than in any other country ; this is supported by the considerable experience of quick-freezing on land in both air blast and contact type freezers and by a very considerable body of experimental and practical knowledge in the production of quick-frozen fish of the highest quality.**

"MANY experiments into freezing at sea have been carried out over the past 40 years, of which the *Arctic Prince* and the *Arctic Queen* (originally British) were two of the earliest. During and since the second world war there have been the *Hamburg*, *Weser* and now the *Heinrich Meins* (German), the *Mabrouk* (French) and the *Silver Lord*, *Fairfree*, *Fairtry* and *Northern Wave* (British). The 24 '*Pushkin*'-class with their successors now building (U.S.S.R. and Poland) and the two new ships building in Great Britain may be considered as the practical outcome of these experiments, though there is no doubt that further great improvements are possible and will soon be made in almost every feature of the ships' designs, stated Commander M. B. F. Ranken, M.I.MAR.E., A.M.I.N.A., M.INST.R., of J. & E. Hall Ltd., in a paper presented before a joint meeting of commissions 3, 4 and 5 of the International Institute of Refrigeration in Moscow in September.

"Three main methods of operation of freezing trawlers are possible, as follows :—

(*a*) Fish factory trawlers : In current practice these are mostly ships of around 2,500 gross tons, such as the *Fairtry* and '*Pushkin*'-class, with refrigerated holds of capacity between 500 and 800 tons, as well as fish meal stores and fish oil tanks.

(*b*) Fish factory and mother ships : These work in conjunction with a group of small trawlers or other fish catchers and are usually in the range 8,000 to 12,000 gross tons. They are thus a much larger version of (*a*) above without the trawl gear.

(*c*) Standard size distant water trawlers : These are mostly ships of 180 to 200 ft. overall and 600 to 700 gross tons.

"Both (*a*) and (*b*) above are equipped with a complete range of factory equipment and the best designs can process every part of the fish. The freezing methods employed in both are similar and need not be considered separately.

Methods of Freezing Fish

"There has been much argument in recent years about the most suitable methods to be used for freezing fish at sea. Thus the *Fairtry* has on one side of the ship a development of the 'Fairfreezer' which is really a combined horizontal plate freezer and freezing tunnel, while on the other there are three horizontal plate freezers. The '*Pushkin*'-class on the other hand have two freezing tunnels and the same method is to be used for the first of her successors.

"The two successors to the *Fairtry* will have five horizontal plate freezers arranged side by side athwartships across the factory deck, and the *Northern Wave* and *Sir William Hardy* have Torry-Hall vertical plate freezers.

"British experience both ashore and afloat now leads to the conclusion that the most satisfactory method so far for freezing fish in factory trawlers is by means of plate freezers. The only practical alternative is the freezing tunnel, but this has several serious disadvantages as follows :—

(*a*) It occupies between two and three times the space and is nearly twice the weight.

(*b*) It is considerably more complicated in construction than are plate freezers, especially if the trucks are to be power-operated and the fish compressed in the trays.

(*c*) The refrigeration demand is considerably greater than for plate freezers on account of the forced-draught fans, and lower refrigerant evaporating temperatures must be used, which may introduce additional complications.

(*d*) Desiccation and oxidation of the surface of the fish may occur.

(*e*) Heavy mechanically-operated doors are required.

"All the above disadvantages can be overcome with plate freezers. Compression of the fish in the trays is inherent in the design and the doors become redundant if a 'letter box' type of construction is adopted opposite the entry to and exit from each tray. While the single ram type of horizontal plate freezer is the most common, a double ram type now available allows less movement of the plates and may save some headroom.

"Some slight build-up of frost inevitably occurs in service and this is about twice as bad at sea as on shore, but it need be no worse on plate freezer plates than on tunnel air coolers and it can readily be removed in a few minutes by hot refrigerant. Daily defrosting will prevent any appreciable deterioration of output. Vertical plate freezers are immune from this trouble, although they still require to be cleaned occasionally.

Refrigerants

"Simplicity, reliability, compactness and safety are of paramount importance in a ship and it may be expedient in a practical installation to sacrifice some efficiency and, therefore, economy of operation, to these essential requirements.

"The *Fairtry* and her successors use Refrigerant-12 ('Arcton-6'; 'Freon-12') as the refrigerant to cool brine, which is circulated through the freezers and cold store grids.

"The '*Pushkin*'-class and their successors use ammonia

for the freezers and to cool brine, which is circulated through the cold store grids.

" The *Sir William Hardy* and the *Heinrich Meins* on the other hand use Refrigerant-22 (' Arcton-4 '; ' Freon-22 ') both for the freezers and for the cold store.

" The *Northern Wave* used Refrigerant-12 (' Arcton-6 ' ; ' Freon-12 ') with pump circulation both for the freezers and cold store grids.

" When ammonia is used in applications requiring an evaporator temperature lower than about –10° F. (–23° C.) this inevitably involves two stages of compression with intercooling. Single stage compression becomes unsatisfactory below this temperature because of the very high compressor discharge temperatures which result and which may lead to lubrication problems. The volumetric efficiency also becomes low as the evaporation temperature is reduced. The use of two stages with intercooling inevitably produces a more complicated refrigerant circuit, takes up more space and weighs more than a single-stage system, all of which are undesirable features for ships' installations. Ammonia is also undesirable in ships because of its explosive, toxic and lachrymatory properties. The action of ammonia on non-ferrous materials makes it necessary to use steel condenser tubes, which must inevitably corrode in contact with sea water. Leaks are also liable to cause damage to equipment made of copper or its alloys. Ammonia is, therefore, undesirable for ships particularly in cases such as fish factory ships, where very congested refrigerating machinery rooms are necessary to accommodate the large plant involved. If ammonia is used good ventilation is essential.

" Refrigerant-12 has been used in single-stage plants operating with an evaporating temperature as low as –40° F. (–40° C.), but the volumetric efficiency of single stage reciprocating compressors may drop below 40 per cent. under these conditions and excessively large machines are, therefore, needed for a given refrigeration duty.

" On all counts Refrigerant-22 appears to offer the best properties for single-stage refrigerating plants to operate in ships at evaporation temperatures down to –40° F. (–40° C.). The b.h.p. absorbed is no higher than for Refrigerant-12 and is much less than for two-stage ammonia plants ; the machine size required is much less than for Refrigerant-12, and Refrigerant-22 evaporates above atmospheric pressure even at –40° F."

New Companies

The accompanying particulars of New Companies recently registered are taken from the Daily Register compiled by Messrs. Jordan and Sons Ltd.

Hay's Wharf Haulage Ltd., St. Olaf House, S.E.1. Nominal capital : £100. Directors not named. Subscribers: G. A. Hosker (Solicitor) and Geo. A. Smith (Clerk), 11, Old Jewry, E.C. Registered by solicitors, Clifford-Turner & Co., 11, Old Jewry, E.C.2.

J. T. Meredith (Heating) Ltd., 6/8, Malt Street, S.E.1. Secretary : H. K. Tomlin. To carry on business of heating, ventilating, air-conditioning and sanitary engineers, etc. Nominal capital : £1,000. Directors : Alfred E. Watson, 2, Cavendish Road, Sutton ; Arthur T. Shirley, 108, Pickhurst Lane, Hayes, Bromley. Registered by Shaw & Sons Ltd.

J. T. M. (Engineers) Ltd. Details similar to J. T. Meredith (Heating) Ltd.

Refrigeration G. & H. (Distributors) Ltd., 48, Granville Road, E.17. Secretary : F. J. S. Wood. To carry on business of inventors, designers, manufacturers of and dealers in refrigerators, etc. Nominal capital : £1,000. Directors : Charles L. Gabb, 94, Withymead, E.4 ;

(*continued foot of next column*)

REFRIGERATED CARGO TONNAGE

FIGURES FROM LLOYD'S REGISTER, 1958-9

The following interesting figures, relating to world shipping (including British) classified with Lloyd's, show the proportions for which the various refrigerating machine makers have been individually responsible.

Total listed refrigerated capacity—113,021,488 c.ft.

Refrigerating Equipment Supplied by	Capacity c. ft.	Percentage of total
J. & E. Hall, Ltd. (incorporating Liverpool Refrigeration Co.)	78,171,603	69·17
S.T.A.L.	7,561,746	6·69
Thomas Sabroe & Co.	5,334,965	4·72
L. Sterne & Co. (incorporating Haslam Eng. Co.)	4,764,323	4·22
Bergedorfer Eisenwerk	3,135,930	2·77
Atlas Maskinfabrik	2,175,431	1·92
Drammen	2,145,358	1·90
Atlas Werke	1,878,220,	1·66
Carrier Corporation	1,093,458	0·97
Lebrun	924,192	0·82
Barbieri	859,426	0·76
Ingersoll-Rand Co.	600,000	0·53
Grasso Mach.	593,960	0·53
Sabroe of Japan	535,885	0·47
Brown Boveri et Cie	508,870	0·45
La Loire	489,260	0·43
De Schelde	472,947	0·42
Borsig	448,229	0·40
Kheinkalte-A	223,500	0·20
Apeldoorn-Landaal	217,938	0·19
York Corporation	200,734	0·18
Termomeccanica Italiana ...	147,492	0·12
Paul Duclos	119,630	0·11
Others (see below) ... ... Under 100,000 c.ft. each	418,391	0·37
Total	113,021,488	100·00

Others consist of—Odero-Terni 88,232 ; Werkspoor 50,792 ; Lightfoot 34,800 ; Ramon Vizcaino S.A. 34,410 ; Doyle & Roth 32,572 ; Universal Cooler 30,760 ; Taisyo Kinzoku Kogyasyo 20,860 ; Airtemp 18,362 ; General Motors Corporation 16,700 ; Westinghouse 12,635 ; Voorwaarts 10,888 ; S.A.M.I.F.I. 10,800 ; G.E.C. 9,830 ; Chrysler Airtemp 8,561 ; Brunner 8,450 ; Technical Bureau Kobach 7,950 ; Frigidaire 7,720 ; Astra Kuh. Werke Landaal-Schelde 7,320 ; Kalte Richter 4,090 and Mitsubishi Electric 2,659. Total 418,391.

Montague R. Hadrys, 57, May Avenue, Canvey Island. Registered by Jordan & Sons Ltd.

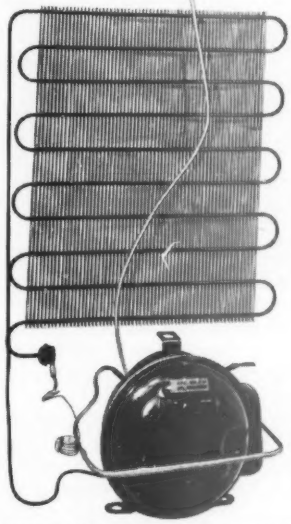
Brands (Bristol) Ltd., 59, Lower Union Street, Bristol. Secretary : Margaret B. Brand. To carry on business of manufacturers of and dealers in domestic and household appliances, refrigerators, washing machines, etc. Nominal capital : £2,500. Directors : George R. Brand and Mrs. M. B. Brand, 161, Newfoundland Road, St. Paul's, Bristol, 2. Solicitors : Meade King & Co., Bristol, 1. Registered by Shaw & Sons Ltd.

6 GOOD POINTS FOR BUYING...

Sternette

DOMESTIC CABINET SYSTEMS

Illustrated is the Sternetic System Model 57.U (5.7 cu. ft.)



1. Large capacity deep freeze storage.
2. Available with beautifully styled doors.
3. Powered by the famous Tecumseh Pancake Unit.
4. Instant release flexotrays.
5. New roll bonded aluminium evaporators.
6. Hermetic Unit covered by five year guarantee.

L. STERNE & CO. LTD.

HERMETIC UNIT DIVISION

(Licensees of Tecumseh Products Co. Mich. U.S.A.)

Works:
KELVIN AVENUE, HILLINGTON, GLASGOW, S.W.2.

BRANCH OFFICES—London · Derby · Cardiff · Bristol · Liverpool · Newcastle · Hull · Aberdeen · Belfast · Dublin
Export Office: 2 Caxton Street, London, S.W.1. Tele: Abbey 6631. 'Grams: Sternette, Sowest, LN. Cables: Sternette, London

Advances in Climate Control

REFRIGERATION men have finally convinced most Americans that it is old-fashioned to put up with the weather. Now, the industry is growing faster than ever before as it tries to meet demands for made-to-order climates everywhere from Greyhound buses to deep-sea diving bells, states *Ansul News Notice*.

Refrigerant charges are shrinking in size. Much equipment is being manufactured without complete pump-down capacity—for instance, in automotive air-conditioning as well as other air-conditioning and refrigeration fields.

Nothing but a question mark several years ago, automotive air-conditioning is now a major addition to the industry. The repair and replacement of auto air-conditioners have brought a steadily rising demand for component parts.

Many of these new demands call for components with the flexibility of Ansul T-Flo drier construction. Ansul has marketed a line of receiver-driers which provide a simple, common sense solution when refrigerating systems require a small charge. Ansul's receiver-driers are already in use in factory-installed automotive air-conditioning.

"Do you build, install or service equipment carrying sealed or semi-sealed compressors? If so, you'll be especially interested in the throw-away feature of Ansul receiver-driers. When trouble develops, receivers store acid, oil breakdown materials and other undesirable by-products of system failure as well as refrigerant. They are virtually impossible to clean. However, when an Ansul receiver-drier is installed with the system, the contaminated receiver can be thrown away and replaced with a new one without breaking the line," states *Ansul News*.

Each of the receiver-driers, now available at Ansul wholesalers, is a complete package. A moisture indicator, sight glass, drier, two stage filtration and receiver capacity are all combined in a two-piece unit. The connector is available in $\frac{1}{4}$ inch and $\frac{3}{8}$ inch flared connections. However, it is not interchangeable with the conventional Dry-Eyes because of flow differences. A fusible plug in the fitting is an optional feature at additional cost. The connector, like all T-Flo fittings, is a permanent liquid line installation and leakproof joints need not be disturbed to replace the receiver-drier cartridge. Its conventional "Freon-12" indicating element shows blue when dry and pink when wet. The coolers are completely reversible.

Receiver-drier cartridges are supplied in 12, 20, 30 and 42 cubic inch receiver capacity and all cartridges are interchangeable in all fittings.

The new receiver-driers are easy to install and cartridges can be changed in a few minutes. They are adaptable to any system carrying a small charge—even to being used as an accumulator drier. Ansul has made an efficient approach and a logical application to to-day's air-conditioning and refrigeration problems.

Special Refrigeration Vehicle Further Developed

READERS will recall that in our February, 1958, issue we described an advanced design of insulated vehicle which had been developed by Mr. R. Saunders, of Thermal Closures and Containers Ltd., for Southern Frozen Products Ltd., wholesale distributors, of Brighton.

The vehicle, as described, has been employed throughout this year on frozen foods delivery in the Southampton area, having been permanently transferred to that end of S.F.P.'s territory.

Operation of this vehicle has proved so successful, we learn from Mr. H. Vigor, managing director of the Brighton firm, and the thermal calculations so accurate, that a second body, incorporating the same principles, has now been supplied to the company.

In this model, called Mark 2, the same main

features have been incorporated, but modifications and refinements have been introduced in the light of experience, and to conform with the special requirements of a slightly different type of trade.

It will be remembered that the central feature of the design was the elimination of any conventional door, and the substitution of a sliding canopy as a means of entry. By the use of this, the heat exchange was reduced to a minimum which could hardly be improved upon, and entry by any other means was quite impossible. This principle has been retained, but the projection at the rear of the prototype to accommodate the canopy has now been removed by pivoting the canopy longitudinally instead of laterally, slightly changing the mode of entry. This not only tidies up the design, but effects some economy in storage space.

Delivery continues to be effected from two " boots " at the rear, as in the previous model, but these have now been made of larger dimensions. The " boots," which are refrigerated by controlled sublimation of dry ice, are fed at intervals from the main compartment during the day's work. It has been found that entries into the van for this purpose average from 10 to 12 per cent. of the number of delivery " drops."

An additional feature, to conserve the temperature still further, is a moving bulkhead or false insulated walf which, at its fullest extension, is positioned against the forward wall of the van, but which can be moved towards the rear by a system of rail suspension, and bolted into any desired position to contain the load in the smallest possible space. The total available space for the storage of frozen food is about 325 c.ft.

The vehicle returns to depot every night, and a limited use is made of dry ice as a refrigerant. In the insulation, however, are fitted pipes with wide ramifications throughout its area, whereby precooling can be provided by refrigerant or chilled water through appropriate " headers."

Various locking devices make it impossible for the contents of the main compartment to be exposed to ambient temperature at any time, *e.g.* when the " boot " doors are open for unloading.

The container is carried on a 3-ton forward drive Ford Thames Trader provided by G. Davidson & Sons Ltd., of Whitley Bay.

Lightweight, unbreakable stencils which do not warp buckle or degrade are now being produced by Heller & Sons (Engineers) Ltd., 51, Turnpike Lane, N.8, from sheet extruded from Rigidex polyethylene supplied by British Resin Products Limited. Cut from 0.020, 0.025 or 0.030 in sheet depending on the area of the stencil and the size of the lettering. the new stencils are essentially rigid, although they will readily flex to fit virtually any contour.

Control of Dehumidification and Attemperation *

B. C. OLDHAM and B. D. MOUL
(*United Kingdom*)

IN the p. v. t. relationship of volatile fluids higher dewpoint temperatures are synonymous with higher vapour pressure. This applies both to water vapour in air and to the refrigerant in a closed circuit, and can be utilised for simplification of control systems with the accompaniment of improvement in performance.

It is not always necessary to reduce the sensible heat of the air which forms the vehicle for the conveyance of the water vapour to be removed from the air; the disposition of the " air coolers " which are in effect water vapour condensers on one side of the heat transfer surface and refrigerant evaporators on the other can be designed in such a way as to improve the vapour pressure relationships in both water-bearing air and in refrigerant. The rate of diffusion of water vapour through air is often overlooked ; complicated controls of air movement and attemperation are often installed when only control of water vapour pressure differences is needed.

Variations in humidity of air with seasonal changes or phases of factory processes are accompanied by variations in water vapour pressure which are in logarithmic rather than arithmetic relationship to the temperature.

The application of this principle to refrigeration methods of dehumidification lies in the provision of two or more evaporators, one of which is designed for the minimum duty feeding the normal piston suction in the case of reciprocating compressors or the first stage of centrifugal compressors ; this provides a constant duty from the load which is most persistent.

The variable portion of the duty, *i.e.* the removal of the increase in latent as well as sensible heat imposed by varying weather or process temperature and humidity, can most satisfactorily be dealt with by auxiliary evaporators attached to compressors in such a way as to be independent of piston or first stage suction, thus entering the compressor as a supercharge. By this means the compressor capacity is variable and continually changing with the duty in a self-acting manner without need of controls. The control system is thereby considerably simplified.

Variable capacity upwards with self-changing evaporating temperature, and absence of any additional moving parts is rendered possible and desirable by taking advantage of the different quality of cooling offered by the seasonal fraction of the refrigerating load. The complications of the conventional miscellany of ancillaries which in the main give variable capacity downwards may be appreciably simplified

Several new fluids have become available as refrigerants, and most of these have more favourable ratios of specific heats C_p/C_v than the older refrigerants, resulting in compression temperatures much nearer to the isotherm.

Water jacket cooling of supercharged compressors is therefore no longer of importance and intake of the refrigerant to compressors in a dry or superheated condition is practical. The principal obstacle to unattended operation of supercharged compressors is therefore removed and the present-day importance of air-conditioning as a market outlet for refrigeration renders exploitation of this system highly opportune.

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*Synopsis of paper recently presented at the I.I.R. meetings in Moscow.

Operating I.C. Engined Lift Trucks Indoors

IN the last few years, increasing production and rising labour costs have brought about intensive development of mechanical handling of goods and materials. There has been a particularly sharp increase in the number of fork lift trucks in use, both the electrically driven and internal combustion engined models. Of these two types, the latter (fitted with diesel and in some cases petrol engines) is invariably superior in speed, power and lifting capacity and has the added advantage that it can work almost continuously without needing "time off" to have its batteries recharged or replaced. Against this, of course, the diesel or petrol driven fork lift truck has the serious disadvantage that its exhaust emits fumes containing a high proportion of carbon monoxide, safe enough in the open air, but a serious problem in enclosed premises.

At Carlsberg Brewery Co. Ltd. Hyster fork lift trucks powered by Bottogas are used both indoors and out to transport pallet loads of the famous Carlsberg Lager.

Several industrial concerns, anxious to enjoy the superior performance of internal combustion engined fork lift trucks, have installed special air ventilating systems so that this form of truck can be used in enclosed premises. Even so, the cost of such installations weigh heavily against the economy of even the diesel engined truck and, with the best designed air ventilating system ever produced, it is still impossible to obtain complete freedom from fumes.

Recently, however, the fumes problem has been solved, and the way opened to the indoor use of internal combustion engined trucks by a new fuel called Bottogas (butane in liquid form), marketed by Bottogas Ltd., a company controlled by Shell-Mex & B.P. Ltd. Bottogas is a product of oil refining and is already used in many industries for a wide range of applications, where it is known as L.P.G. (liquefied petroleum gas).

As a fuel for the internal combustion engine it has the tremendous advantage that it gives very nearly perfect combustion. The percentage of carbon monoxide in the exhaust is practically negligible and only light carbon deposits are formed in the engine. This means that it is possible to use an I.C. engined truck in enclosed premises without any danger or discomfort to personnel and, furthermore, without danger of contaminating certain materials which can suffer from atmospheric pollution, such as tobacco, the ingredients of certain foods and drinks, cosmetics.

Secondly, liquefied petroleum gas when burnt in the cylinders of an internal combustion engine, does not produce the carbon which causes fouling of valves and sparking plugs, nor does it dilute the crankcase oil. In this way L.P. gas can show considerable economy to fork lift truck operators by savings on lubricating oil and by allowing much longer periods between engine overhauls.

In most industrial applications, L.P. gas is supplied in cylinders and the supply is drawn off as a dry gas. This system is perfectly satisfactory where the load is reasonably constant. But as the demands of internal combustion engines vary enormously between idling and working at full throttle, it was found that a cylinder of the size to be used on a lift truck experienced "icing-up" troubles during sudden surges. Bottogas Ltd. have now overcome this problem by designing a special cylinder holding 40 lb. of liquefied pertoleum gas, which delivers the mixture as a liquid. Vaporization then takes place in a special vapourizer which is warmed by the heat of the engine. Consequently, the Bottogas powered truck is extremely flexible in operation, giving a performance comparable with that of a well-tuned petrol engine using 100 octane fuel.

Mr. C. R. Purley told Woodrow Wyatt and 7,250,000 people watching B.B.C.'s Panorama last month that the aircraft he uses as a flying sales showroom costs only 2s. 9d. a mile to run—little more than the cost of taking a London taxi. "That's taking our pilot's costs and everything into consideration," said Mr. Charles Purley, chairman of Lec Refrigeration Ltd., Bognor Regis. "With six or eight passengers it becomes a very economical form of transport."

SPEEDING REFRIGERATION DELIVERIES

To facilitate the movement of refrigerator bodies between their Llandudno Junction and Peterborough factories, two 7-ton Commer chassis, fitted with Luton type van bodies and towing trailer units, have been put in service by The Hotpoint Electric Appliance Co. Ltd.

The vans and trailers supplied by Rootes main dealers, Clarke Bros., Peterborough, are fitted with two detachable floors giving a loading area of 1,024 square feet, thus enabling some 240 cabinets to be transported at a time.

It is estimated, working on the basis of nine round trips every four weeks, that the vehicles will each cover between 45,000 and 50,000 miles annually.

Both the van and trailer bodies which are framed with steel reinforced hardwood, braced with diagonal members and clad in 18 gauge light alloy sheet, were built by Cecil Saunders Ltd., Letchworth, Herts, To facilitate loading and offloading, both units are fitted with a 2 ft. 3 in. high tailboard and half door.

The outfits are finished in a new Hotpoint design, the lettering being in vermilion, a colour which clearly stands out against the mist grey and sage blue background.

TEMPERATURE TOLERANCE OF FROZEN FOODS

SCIENTISTS working at the Western Utilization Research and Development Division, Agricultural Research Service, U.S. Department of Agriculture, have recently carried out fundamental investigations on time-temperature tolerance of commercially packed frozen foods.

Losses in frozen-food quality at various temperatures needed examination. The scientists asked themselves :—

Is steadiness of temperature, in addition to low temperature (zero F. or lower), important in the protection of high quality in frozen foods ? Do fluctuations, such as those between day and night operation or cycling of equipment, accelerate the loss of quality ?

The result of the research has shown that at each level of temperature, chemical reactions that cause losses of colour, flavour, or vitamins move at certain rates. At various levels the changes take place faster or slower, and their effects accumulate. The movement up and down, however, does not make any special contribution to the speed of the reactions.

Proof that unsteadiness has no separate effect resulted from a study of " effective " temperatures of fluctuations of various times and ranges, scientists in the Western Laboratory worked out a method for *calculating " effective " temperature*, which is the steady temperature at which the same quality loss would take place in a specific fluctuation if unsteadiness had no separate effect.

Then, working with commercial frozen strawberries and raspberries, they discovered that rates of losses of vitamin C, colour, and flavour follow the calculated pattern of effective temperatures closely. In fluctuations from zero to 20° F., for example, the effective temperatures were 4° or 5°

Temperature tests on typical packages.

higher than the averages. That is, the rates of quality loss were similar to rates at 14° or 15° F. rather than at the average of 10° F.

Agreement of these experimental results with the calculated pattern means that the fluctuation itself, the unsteadiness of temperature, contributed nothing to the loss of quality. Effective temperatures were higher than average temperatures because rates of these changes are much faster in the upper temperature levels of the fluctuations.

Other research in the same project has shown, however, that movement of moisture from frozen turkeys can be increased by fluctuating temperature. More frost accumulated in polyethylene packages of turkeys fluctuated from minus 10° to plus 10° F. than in similar packs held steadily at plus 10°, the highest level of the fluctuation.

The two packs were, however, equivalent in eating quality because the moisture removed was insufficient to make a detectable difference in the cooked products. According to the findings of the researchers, *moisture movement from frozen foods is not a chemical change*, and moreover it is well controlled by modern packaging and improved storage conditions. In the earlier history of the frozen foods industry it was much more important but still can cause trouble if it is not adequately controlled.

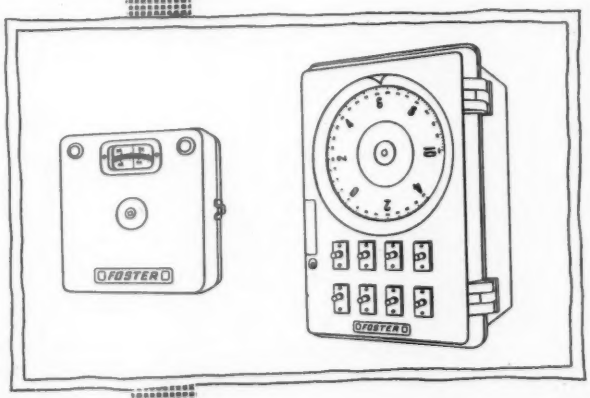
One of the special low temperature rooms used in research on temperature tolerance of frozen foods.

Mobile Ice Cream Makers.—Ice cream, freshly made on the spot from vans fitted with ice cream manufacturing equipment, is now available in Britain. The vans, based on Karrier Cruiser 1-ton short wheel-base chassis, are equipped with power plants, continuous soft ice cream freezers, conservators for ice cream mix storage and a water supply. An example of this new equipment was

TEMPERATURE MEASUREMENT by FOSTER

in the new Frozen Food Store of Birds Eye Foods Limited at Salfords, Surrey

The temperature control panel shown is of the fully cubicle type housing six non-indicating electronic resistance thermometer controllers for cold room and floor temperatures, switching arrangements being such that any one of the thermometer elements in the building could, if necessary, be selected for control. An electronic indicator enables a routine check to be made on the temperatures of the 20 thermometers installed in different parts of the building.



Left: Foster Non-Indicating Electronic Resistance Thermometer Controller, range −40° F. to +80° F. arranged for ON/OFF control and having differential adjustable between −5° F. and 3.0° F. to suit plant requirements. Scale length 15 in. Calibrated accuracy 0.25% of scale span. Available in a number of stock ranges all models having Centigrade and equivalent Fahrenheit scales as standard.

Right: Foster Electronic Self-balancing Indicator having 10 in. diameter scale with effective length of 25 in., calibration being for a range of −40° F. to 100° F. Fitted with double-pole switches for the measurement of up to 24 points, switches having duplicated rare metal contacts. Available with calibration for other ranges and with independently adjustable contacts for alarm signalling and for 2, 3 or 4 positioned control.

Technical literature gladly sent on request.

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exhibited on Karrier Motors stand at the Commercial Motor Show, Earls Court, recently. The dispensing of ice cream by mobile vehicles has been developed in the United States, the biggest single American operator being the " Mister Softee " concern. This company controls well over 300 mobile dispensers through out the States. To operate a similar service in the United Kingdom and overseas a new company is being incorporated under the title of " Mister Softee (International) Ltd." The company intends to offer franchises to retailers and others interested in the distribution of freshly made ice cream. The vehicles to operate this new fleet are to be built and equipped by Smith's Delivery Vehicles Ltd., Gateshead-on-Tyne, and based on Karrier Cruiser short wheel-base chassis.

Eighteen-year-old Christina Gregg, of Pinner, Middlesex, and Pat Kildare, of London, demonstrate one of the highlights of the 1958 Commercial Motor Show " Mister Softee "—the first mobile ice cream factory in Britain. Mounted on a Karrier Cruiser chassis with bodywork by Smith's Delivery Vehicles Ltd., of Gateshead-on-Tyne.

REFRIGERATION PATENTS

These new refrigerating patents have been specially selected for readers by MODERN REFRIGERATION from the Official *Journal of Patents*, and are published by permission of the Controller of H.M. Stationery Office.

COMPLETE SPECIFICATIONS ACCEPTED

July 23—Centre National de la Recherche Scientifique, 801,585, Storage of grain or other perishable substances ; Texaco Development Corporation, 801,646, Alkylation with effluent refrigeration and flashed vapour absorption. 30—Pressed Steel Co. Ltd., 801,797, Reverse cycle defrosting system for refrigerators ; Luwa Akt.-Ges., 801,798, Air-conditioning device. August 7—General Electric Co. Ltd., 802,271, Heat exchangers ; Borsig Akt.-Ges., 802,309, Liquid separating arrangement for compressors, especially compressors for refrigerating agents. 13—Normalair Ltd., 802,783, Cooling of cabins or other habitable parts of aircraft ; Linnell, R. E., Linnell, P. R., Linnell, T. R., and Linnell, T. E., 802,485, Preservation of perishable commodities by refrigeration ; Pressed Steel Co. Ltd., 802,756, Refrigerator cabinets ; General Motors Corporation, 802,765, Refrigerator motor-compressor unit ; Meadows, C. A., 802,602, Artificial ice rink ; Carrier Engineering Co. Ltd., 802,773, Absorption refrigeration systems and their method of operation. October 15 — Borg-Warner Corporation, 805,711, Machine for making blocks of ice ; Alumasc, Ltd., and Lewis E. C., 805,668, Fluid cooling or heating apparatus. 29 — Rheostatic Co., Ltd., 806,171, Temperature control systems ; Vapor Heating Corporation, 806,294, Thermostatically regulated temperature control system. November 5—British Thomson-Houston Co., Ltd., 806,786, Cooling equipment Teves, H., Teves, E. A., and Tausend, M., (trading as Teves Maschinen- und Armaturenfabrik Komm.-Ges., A.) 806,860, Refrigerant evaporator ; Usines Chausson S.A., Des. 806,577, Method and apparatus for cooling various fluids and more particularly the air in aircraft flying at high speed. 12—General Electric Co., 807,098, Room air-conditioning apparatus.

APPLICATIONS RECEIVED

October 2—Dole Refrigerating Co., Kleist, H. W., C31498, Coolling etc. element. 3—Bosch, G.m.b.H., R., C31641, Refrigeration apparatus. 8—General Electric Co., Ltd., Bury, H., P32123, Thermoelectric cooling devices ; P32125, Air-conditioners. 15—Burger Eisenwerke Akt.-Ges., C32856, Frozen foodstuffs etc. thawing process. 17—Pormor Ltd., Nicolson, F., P33158, Refrigerators defrosting means. 22—General Motors Corporation, C33758, Thermally insulated cabinet ; C33759, Refrigerator cabinet. 24—American Air Filter Co., Inc., C34069, Air-conditioning apparatus. 28—Marley Co., Mart L. T., C34476, Cooling towers. 29—Denisoff A. C., P34674, Refrigerated tanks. 30—Electrolux Ltd., C34845 Absorption refrigerating apparatus ; Tyler Refrigeration Corporation, C34870, Store arrangements. November 3—Bletz, H. W. C35197, Automatic temperature control system ; Smith & Sons (England) Ltd., S. Lamburn, S.A., P35254, Vehicles air-conditioning installations. 6—Brodrene Gram Aktieselskab, C35719, Ice-cream frozen bodies refrigerating preparing apparatus.

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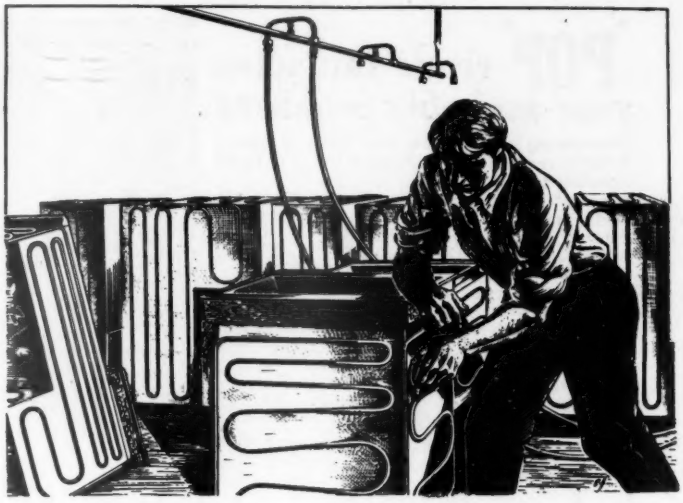

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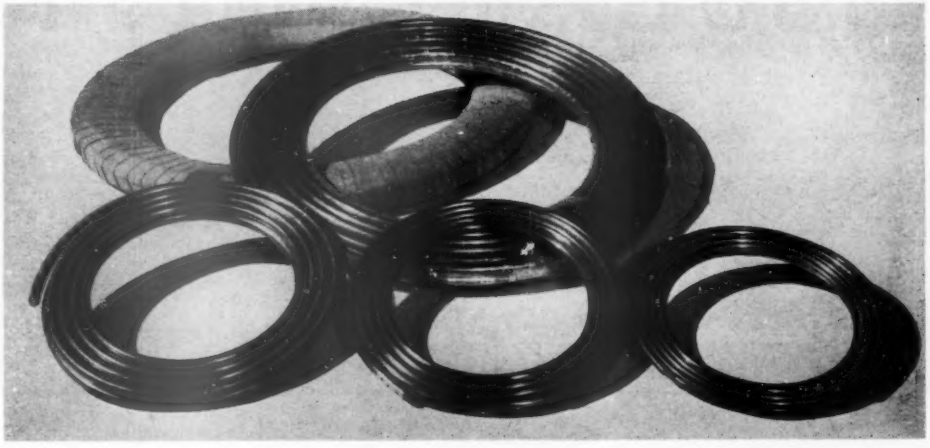
Yorkshire Imperial also manufacture restrictor and bulb-and-capillary tubing—and a range of special "Yorkshire" Fittings for refrigeration work.



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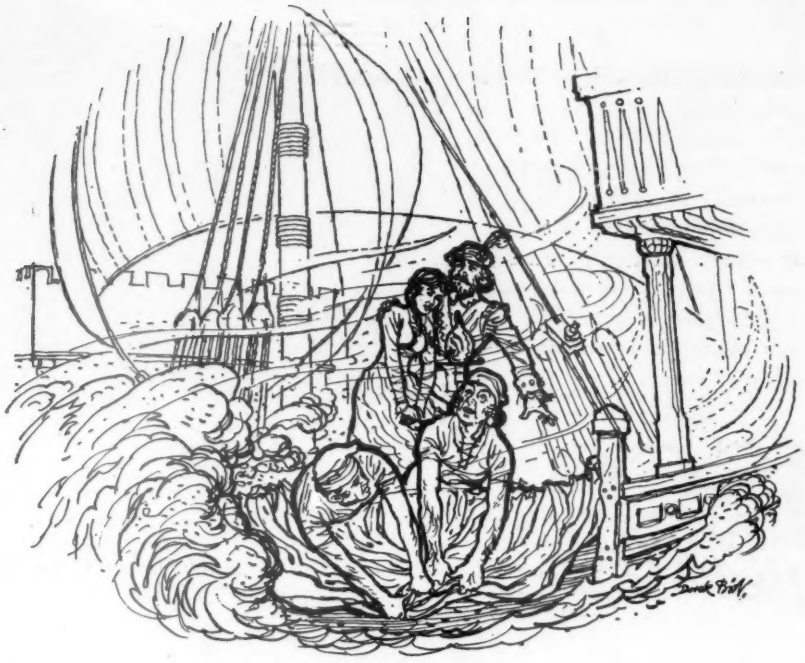

'Go fetch a web o' the silken claith,
Another o' the twine,
And wap them into our ship's side,
And let nae the sea come in.' BALLAD OF SIR PATRICK SPENS

Alas, the sea did come in, as you may remember, and the ship was lost with all hands.

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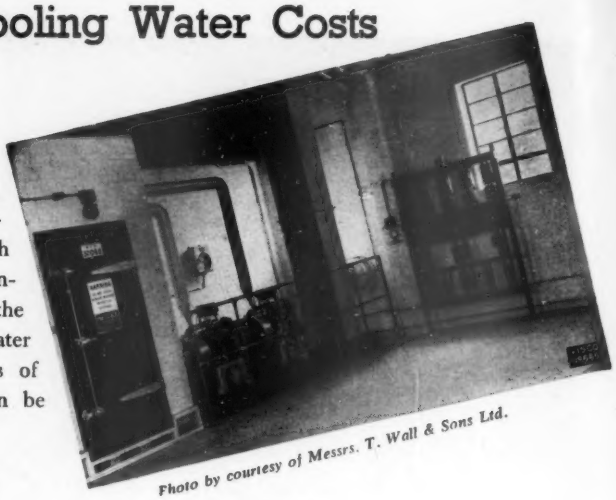

Photo by courtesy of Messrs. T. Wall & Sons Ltd.

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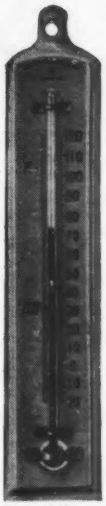

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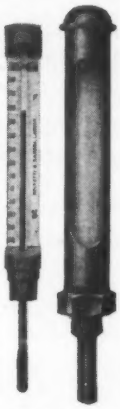
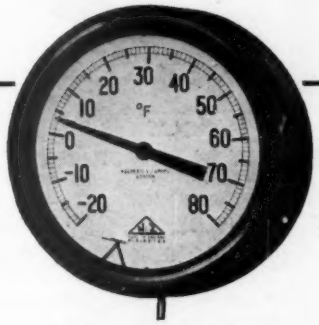


Brine Pipe Thermometers



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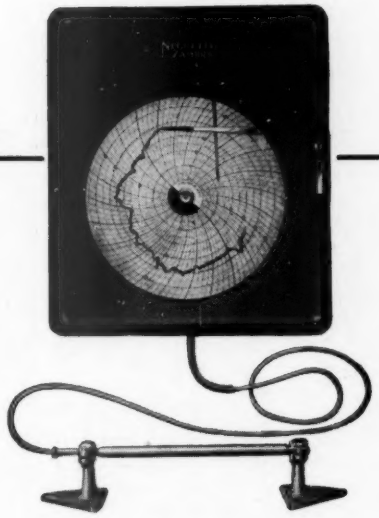

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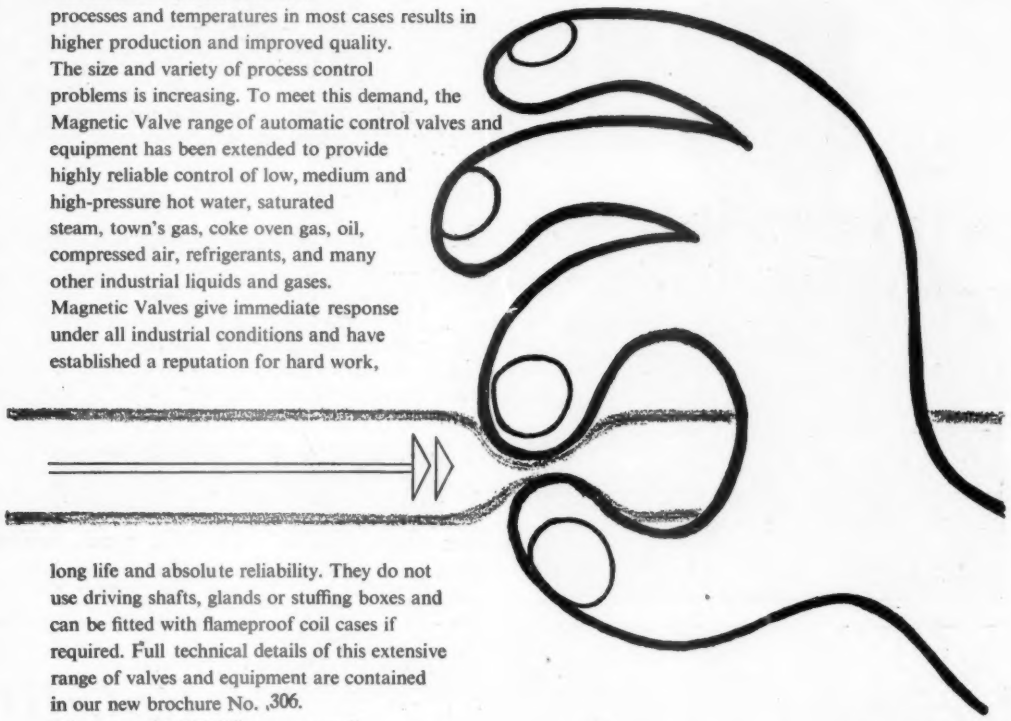

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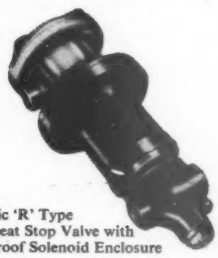
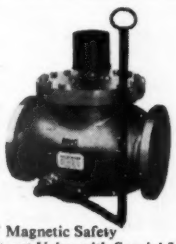


Magnetic 'R' Type Single-beat Stop Valve with Flameproof Solenoid Enclosure



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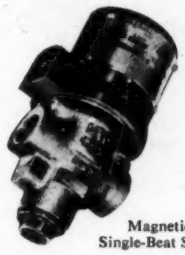

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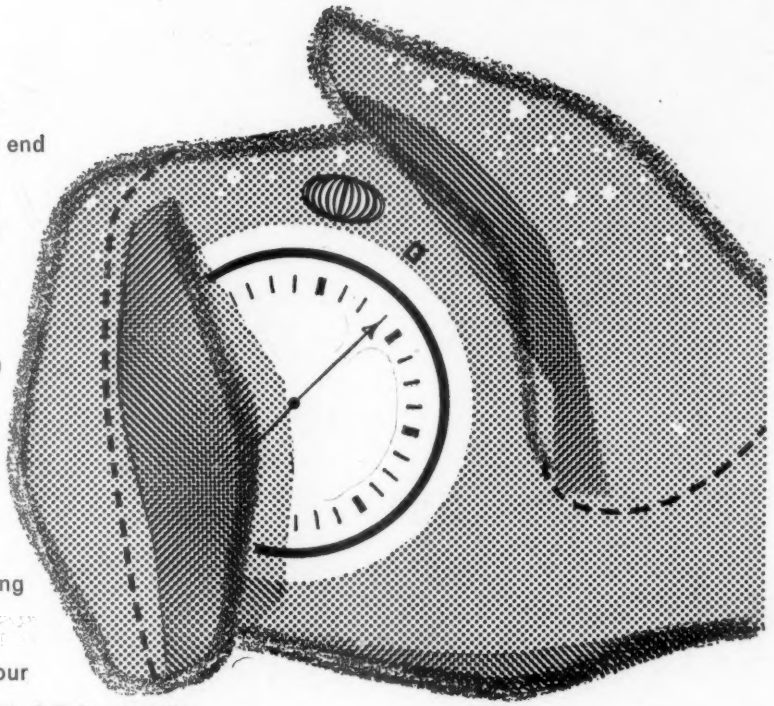

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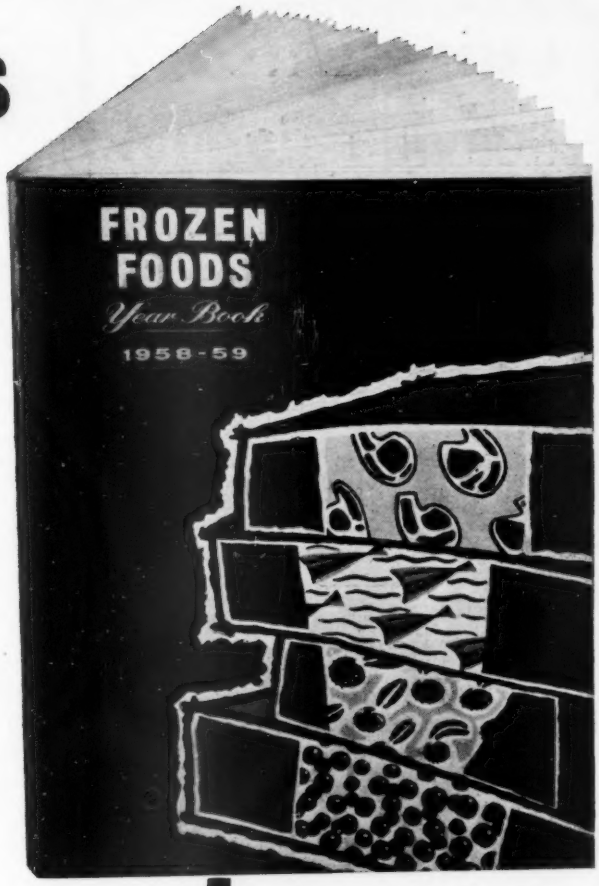
FROZEN FOODS YEAR BOOK 1958-59



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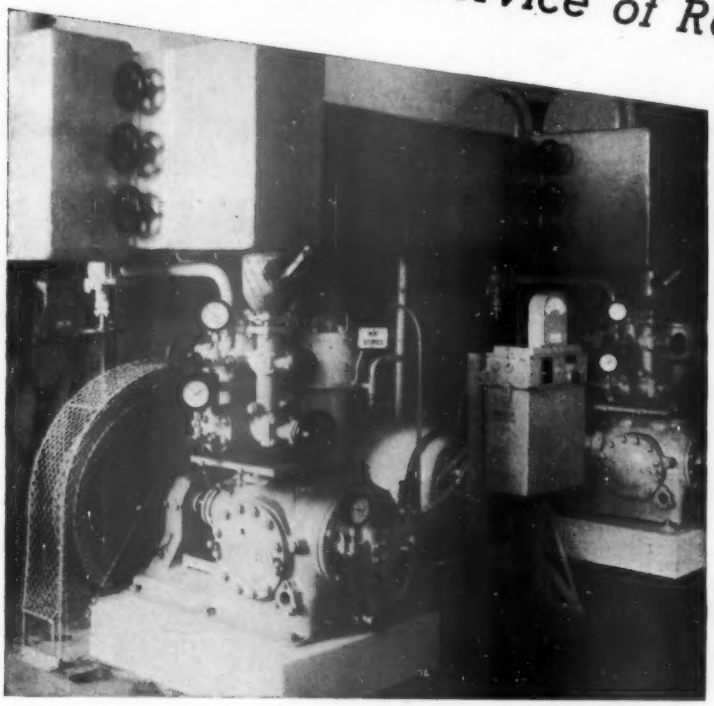

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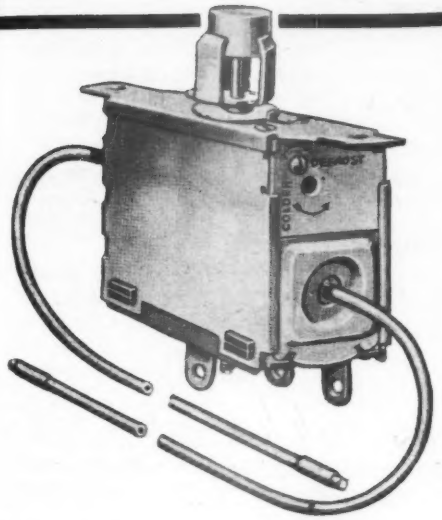
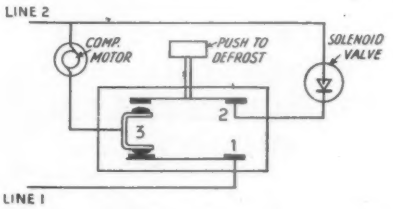
Ranco Ltd

'Ranco' have a complete range of defrosting equipment including Hot Gas defrosting valves

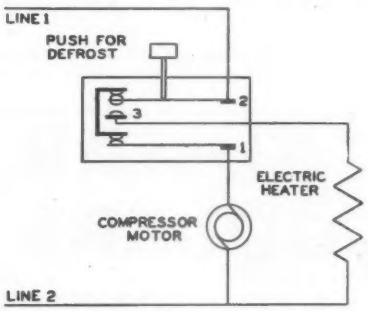
"Here are a few of RANCO AUTOMATIC Defrost Controls acknowledged for progressive design, high quality and lasting reliability and widely used throughout the Industry."



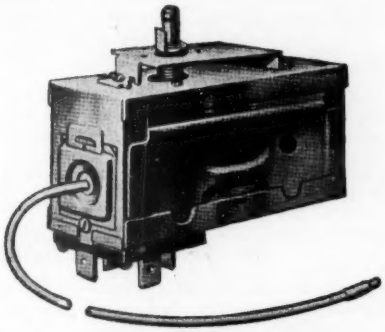
"The Ranco type 'F' controls have been developed especially for the Household



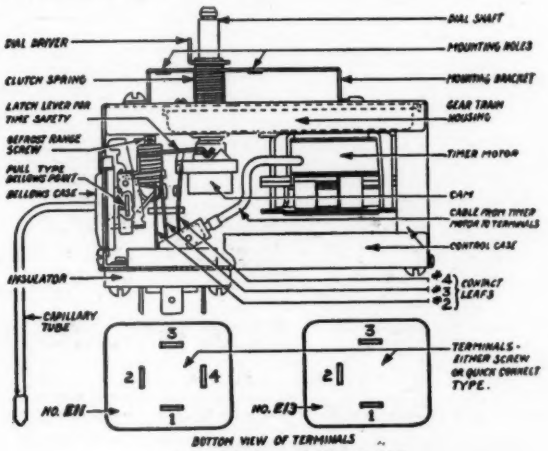
Refrigerator with Push-button defrosting. These controls combine both operations



of DEFROSTING and TEMPERATURE CONTROL. The Type F14 works in conjunction with Ranco 'V' Series Hot Gas Magnetic Valve."



"The Ranco 'E' Series control automatically starts the defrost cycle at a fixed time each day, and stops the defrost cycle at a fixed temperature. This control is in addition to the normal thermostat.



Sectional view of E11 & E13

"The Ranco 'E 11' Control with manufactured synchronous timer motor is designed for Electric Heater Defrost systems and the Ranco 'E 13' control is designed for Hot Gas Defrost systems."

OPERATION

"The Ranco 'E 11' is a single pole *double* throw switch. The 'E 13' Control is a single pole *single* throw switch."

"When the predetermined time for starting the defrost cycle is reached, the defrost circuit closes, operating the defrost device, an Electric Heater or Solenoid for Hot Gas type. The power element, which is only responsive to the evaporator temperature, opens the circuit when the predetermined defrost temperature is reached."

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1104

REFRIGERATION Engineer with not less than five years' experience, able to drive, sound knowledge of reciprocating units all types up to 5 h.p., and sealed unit mechanisms essential; working knowledge of absorption principles an advantage but not essential; for progressive Sales/Service Organisation in London area. Apply in confidence to Box 1082. 1082

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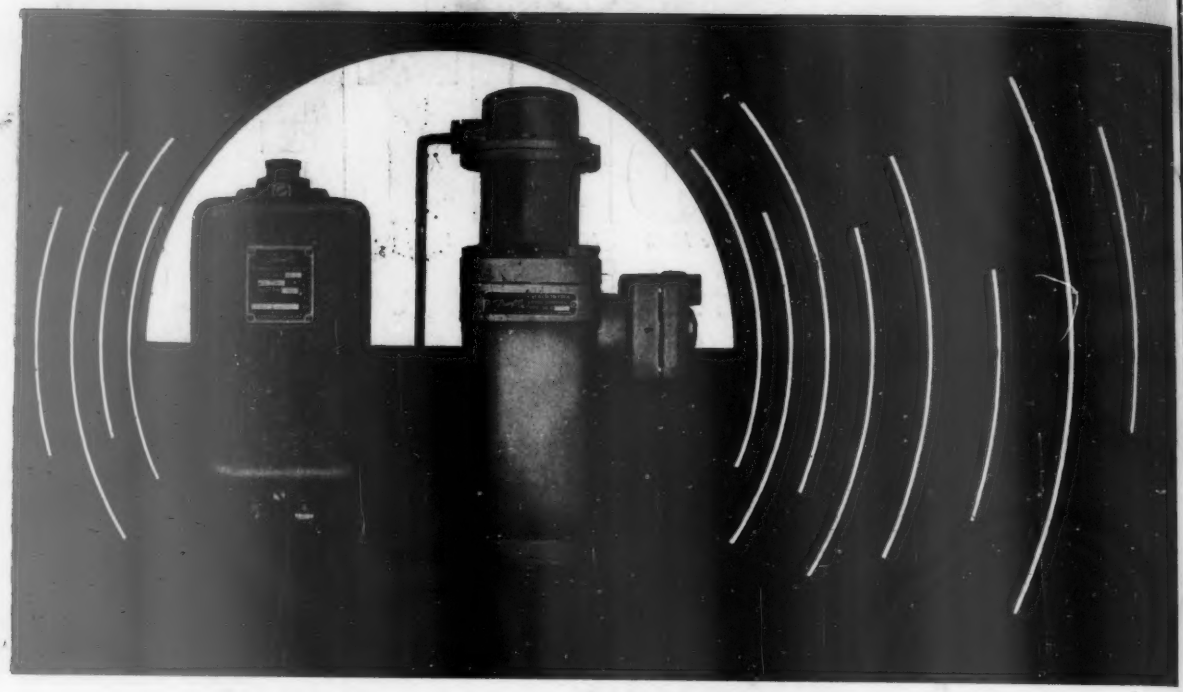

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Further data can be obtained by application to DANFOSS, London.

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NORDBORG, DENMARK

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